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ABSTRACT

An examination of the conventional wisdom that the economy will face a labor shortage was done in three stages. First, the demand side of the labor market was analyzed. Changes in the skill requirements of jobs from 1973-86 were examined as were those changes anticipated by projections of the Bureau of Labor Statistics for 2000. The conclusion was that skill requirements would rise in the 1990s due to shifts in the occupational structure, but at a modest rate that was significantly less than that for 1973-86. Second, expected trends in labor supply--the quantity and quality of the future work force--were analyzed. Conclusions were that a general labor shortage would not occur simply because the labor force would grow slowly in the 1990s and the changing demographics of the work force would not necessarily produce a serious shortage of adequately skilled workers. A problem with labor force entrants would probably be that the educational system will not have provided an adequate basis for future technological innovation and productivity growth. Third, the study examined recent and expected trends in wages and incomes to assess whether future trends would remedy the labor market problems. The conclusion was that wages would continue their sluggish growth and possibly fall for large portions of the work force. The key policy implication was that the "supply push" approach would not produce desired improvements in labor market performance or productivity. (Appendixes include a description of the methodology, 28 endnotes, and a 52-item bibliography.) (YLB)

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The Myth of the Coming Labor Shortage:

Jobs, Skills, and Incomes of America's Workforce 2000

Lawrence Mishel
Ruy A. Teixeira

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Executive Summary

Labor market policies are based on an analysis of labor market trends which defines the focus of policy. Consequently, it is critical that policymakers have an accurate assessment of the labor market.

In recent years, policy discussions have been based on the "labor shortage," or "skills mismatch," view of labor market trends promulgated by the Department of Labor. This labor shortage view, based on the widely disseminated *Workforce 2000* report (Johnston and Packer, 1987), prepared by the Hudson Institute for the Department of Labor, has been the subject of innumerable press accounts and has framed recent policy discussions concerning education and training.

[The "skills mismatch" or "labor shortage view"] ignores significant problems such as the need to improve the pay and skill levels required on the job and misdirects the focus of education and training policy.

This "labor shortage" view contends, first and foremost, that rapid growth of high-skilled professional and technical occupations will rapidly upscale the skill mix of jobs. This is seen as a reflection of the movement toward a "service economy."

The labor shortage view also contends that there will be a slow-growing labor force (leading to an *aggregate* labor shortage) and that this slow-growing labor force will be increasingly dominated by disadvantaged workforce entrants with low skill levels. The result of all this (many more high-skill jobs, coupled with many more low-skill workers) will be a *skills mismatch* between available jobs and available workers.

This view of the near future is, in most respects, either *wrong* or *misleading*—wrong in that key "facts" are contradicted by available data, misleading in that key predictions are more wishful thinking than logical extrapolations of existing economic trends. The consequence is a set of labor market policies that *ignores* significant problems such as the need to improve the pay and skill levels required on the job and that *misdirects* the focus of education and training policy.

This paper provides a detailed empirical analysis of labor market trends which suggests that the conventional "labor shortage" view is incorrect. Our analysis of the characteristics of future jobs shows that:

* Far from an explosive growth of job skill requirements, the effect of occupational upgrading on job skills is actually projected to *slow down* in the future to one-third to one-fourth of its rate in the recent past.

* The differences in skill and pay between expanding and shrinking occupations are projected to *narrow* in the future, rather than widen.

* Upskilling *within* occupations due to technological change does not appear to be widespread and, at this point, may be more *potential* than *actual* within the U.S. job structure.

* Projected changes in the job structure should slightly increase skill requirements at the same time that they *decrease* compensation levels.

Our analysis of labor force trends shows that:

* Slow labor force growth has been associated with *increases* in the unemployment rate in other countries, so an aggregate labor shortage due to slow labor force growth seems implausible.

* Non-Hispanic whites, not minorities, will comprise the majority of entrants to the labor market in the 1990s, comprising two-thirds of the total number.

An exclusively "supply push" approach will not produce desired improvements in labor market performance or productivity.

Because the "labor shortage" view is factually incorrect, it misdirects policymakers. The key error lies in promoting more training and education for workers on the assumption that employers will be demanding a workforce with high levels of skill and education, particularly professional and technical workers. Based on this incorrect assumption of rapid upskilling, the labor shortage view yields a "supply push" set of policies that emphasizes greater worker skills (i.e., more education and training and/or higher immigration levels for educated workers) but no changes in the types of available jobs. *An exclusively "supply push" approach will not produce desired improvements in labor market performance or productivity.*

The flip-side of a "supply push" set of policies is the omission of any policies to affect the composition of available jobs. This means no attention to our trade and competitiveness problems nor to the need for reorganizing work to achieve a high performance production system. Or, in other words, the labor shortage view leads policymakers to focus *only* on the problems with education and training and not on the types of jobs being created by the economy or on how employers structure work.

The labor shortage view also ignores our recent problems with wage and income growth. This is surprising since there was such slow income growth in the 1980s and a dramatic fall in real wages for the three-fourths of the workforce that lack a college degree—a problem especially acute among young male workers. Given these trends, one of the major questions to be asked about the labor market of the 1990s is whether pay levels for these workers in 2000 will be as high as they were in the late 1970s. Unfortunately, *wages are projected to continue their sluggish growth in the 1990s and may, as in the 1980s, fall for large portions of the workforce.* We believe a new set of policies must be put in place to restore wage growth and to correct the wage inequalities that emerged in the 1980s.

The labor shortage view also misdirects the focus of training and education policy. This is because the focus on and overstatement of the increasing number of professional and technical jobs has led to an overemphasis on college education. In fact, even an optimistic view of the labor market suggests that, *at most,* 30 percent of the future labor force will need a college degree, up from about 25 percent in the mid-1980s. Moreover, employment projections suggest that there will be a surplus of college graduates.

In our view, therefore, the point of improving workforce skills should not be to "match" the skills required for an improbable future explosion of professional/technical and other high-skill jobs, but rather to provide a solid base of workforce quality upon which high performance work reorganization can be pursued. This approach makes training and education policies into *active* policies that might alter our growth path rather than *reactive* policies that passively adapt to existing or expected jobs, as in the conventional "supply push" orientation.

Moreover, this approach makes clear that, far from producing more college graduates, *the bigger and more important challenge is to improve the jobs, pay, and skills of the noncollege-educated workforce.* This is because our future productivity and pay levels will depend primarily on pay and performance in the types of jobs noncollege-educated workers currently hold and only partially on moving the workforce into new professional or technical jobs. Training policy should therefore focus on these broad segments of the workforce, so that those workers are able to achieve skill levels adequate to support high performance work reorganization. Approached in this way, broad upgrading of worker skills, coupled with policies that encourage employers to utilize a higher skilled, more empowered workforce, can become a constituent part of a policy mix favoring a "high skill path" for the U.S. economy as a whole.

The point of improving workforce skills should not be to "match" the skills required for an improbable future explosion of professional/technical and other high-skill jobs, but rather to provide a solid base of workforce quality upon which high performance work reorganization can be pursued.

Introduction

Labor market policies are based on an analysis of labor market trends which defines the focus of policy. Consequently, it is critical that policymakers have an accurate assessment of the labor market.

In recent years, policy discussions have been based on the "labor shortage," or "skills mismatch," view of labor market trends promulgated by the Department of Labor. In November 1990, Roberts Jones, Assistant Secretary of Labor Employment and Training wrote,

> As we look ahead to the next ten years, businesses throughout the U.S. will come face to face with a severe shortage of qualified workers. Even as high levels of unemployment persist in certain sectors of our society, the need for better educated, more capable employees will intensify.[1]

[The "skills mismatch" view alleges that] the labor force will be increasingly dominated by disadvantaged workforce entrants with low skill levels while, at the same time, the skill levels of jobs to be filled will increase substantially.

In the words of Elizabeth Dole, former Secretary of Labor, "America faces a workforce crisis" where there is a diminishing number of people eligible and qualified "for the ever-increasing complexity of jobs in our economy" (U.S. Department of Labor, 1990, p. 2).

This labor shortage view, based on the widely disseminated *Workforce 2000* report (Johnston and Packer, 1987), prepared by the Hudson Institute for the Department of Labor, has been the subject of innumerable press accounts and has framed recent policy discussions concerning education and training.[2]

There are several key elements to the analysis underlying the "labor shortage" view. One the one hand, rapid growth of high-skill professional and technical occupations is said to be rapidly upscaling the skill mix of jobs. This is seen as a reflection of the movement toward a "service economy."

On the other hand, the economy will face a "labor shortage," a shortage with two dimensions. The first dimension will be an *aggregate* labor shortage, due to a slow-growing labor force. The second dimension of this labor shortage will be a specific shortage of workers with adequate levels of skill and education. This is because the labor force will be increasingly dominated by disadvantaged workforce entrants with low skill levels while, at the same time, the skill levels of jobs to be filled will increase substantially. The result will be a *skills mismatch* between available jobs and available workers.

There is only one problem with this scenario: it is not likely to happen. In fact, this account of the near future is, in most respects, either *wrong* or *misleading*: wrong in that key "facts" are contradicted by available data, misleading in that key predictions are more wishful thinking than logical extrapolations of existing economic trends. The consequence is a set of labor market policies that *ignores* significant problems such as the need to improve the pay and skill levels required on the job and that *misdirects* the focus of educational and training policy.

This paper provides a detailed empirical analysis of labor market trends which suggests that the conventional "labor shortage" view is incorrect. Our analysis of the characteristics of future jobs shows that:

* Far from an explosive growth of job-skill requirements, occupational upgrading of job skills is actually projected to *slow down* in the future to one-third to one-fourth of its rate in the recent past.

* The differences in skill and pay between expanding and shrinking occupations are projected to *narrow* in the future, rather than widen.

* Upskilling *within* occupations due to technological change does not appear to be widespread and, at this point, may be more *potential* than *actual* within the U.S. job structure.

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* Slow labor force growth has been associated with *increases* in the unemployment rate in other countries, so an aggregate labor shortage due to slow labor force growth seems implausible.

* Non-Hispanic whites, not minorities, will dominate entrance to the labor market in the 1990s, comprising two-thirds of total entrants.

Far from an explosive growth of job skill requirements, the effect of occupational upgrading on job skills is actually projected to slow down in the future to one-third to one-fourth of its rate in the recent past.

Because the "labor shortage" view is factually incorrect, it misdirects policymakers. The key error lies in promoting more training and education for workers on the assumption that employers will be demanding a workforce with high levels of skill and education, particularly professional and technical workers. Based on this incorrect assumption of rapid upskilling, the labor shortage view yields a "supply push" set of policies that emphasizes greater worker skills (i.e., more education and training or higher immigration levels for educated workers) but no changes in the types of available jobs.[3] In our view, an exclusively "supply push" set of policies will not be effective.

The flip side of a "supply push" set of policies is the omission of any policies to affect the composition of available jobs. This means no attention to our trade and competitiveness problems and the need for reorganizing work to achieve a high performance production system. Or, in other words, the labor shortage view leads policymakers to focus *only* on the problems with education and training and not on the types of jobs being created by the economy or on how employers structure work.

The labor shortage view also ignores our recent problems with wage and income growth. This is surprising since there was such slow income growth in the 1980s and a dramatic fall in real wages for the three-fourths of the workforce that lack a college degree—a problem especially acute among young male workers. For instance, the wage of a young, high-school educated man with less than five years experience was 18 percent less in 1987 than in 1979 and equal to the earnings of a comparable worker in 1963. Moreover, the hourly compensation of nonsupervisory workers (about 80 percent of the wage and salaried workforce) fell 0.6 percent annually between 1979 and 1988 (see Mishel and Frankel, 1990). Given these trends, one of the major questions to be asked about the labor market of the 1990s is whether pay levels for these workers in 2000 will be as high as they were in the late 1970s. We believe that a new set of policies must be implemented to restore wage growth and to correct the wage inequalities that emerged in the 1980s.

[The focus on professional and technical jobs] has led to an overemphasis on college education. The bigger and more important challenge is to improve the jobs, pay, and skills of the noncollege-educated workforce.

The labor shortage view also misdirects the focus of training and educational policy. This is because the focus on and overstatement of the growth of professional and technical jobs has led to an overemphasis on college education. In fact, even an optimistic view of the labor market suggests that, *at most*, 30 percent of the future labor force will need a college degree, up from about 25 percent in the mid-1980s. Moreover, employment projections suggest that there will be a surplus of college graduates.

Thus, *the bigger and more important challenge is to improve the jobs, pay, and skills of the noncollege-educated workforce*. Our future productivity and pay levels will depend primarily on pay and performance in the types of jobs that currently exist and will only partially depend on moving the workforce into new professional or technical jobs. Training policy needs to focus on these broad segments of the workforce, so those workers can achieve skill levels adequate to support high performance work reorganization.

Methodology

Assessing whether there are or will be "labor shortages" and/or "skill mismatches" necessarily means examining changes in the quantity and quality of the available workforce (the *supply* side) as well as changes in the quantity and quality of available jobs (the *demand* side). An overall, or aggregate, labor shortage is typically indicated by low overall unemployment. Whether this will occur depends not only on the pace of labor force growth but also on the pace at which employers will be hiring workers. A "skills mismatch" can be said to exist when job-skill requirements exceed the skills of the available workforce. Whether a "skills mismatch" develops depends on whether there is an explosive growth in skill requirements while the quality of the workforce grows modestly, remains constant, or declines.[4]

Whether a "skills mismatch" develops depends on whether there is an explosive growth in skill requirements.

Our discussion of expected labor market trends relies on the Bureau of Labor Statistics (BLS) biannual employment projections. There are several reasons for this. One is that nearly every analysis and journalistic treatment of the future labor market is based on the BLS projections, including *Workforce 2000*. We believe that many of the implications drawn from the BLS data in these analyses are incorrect or misleading because the analyses are either technically flawed or examine the future without any historical context.

A second reason for using the BLS projections is that they are professionally and competently prepared, although subject to the same difficulties that beset any long-term economics projection. The BLS projections should be considered the "best guess" of the accumulated knowledge of roughly 50 analysts with expertise ranging from macroeconomics and demographic trends to the technological and market forces affecting specific occupations and industries. We rely primarily on the BLS projections of industrial and occupational employment growth (and actually take exception to the independently projected trend in wages). In doing so, we assume that relative skill and pay levels in 1988 will be maintained in the future.

Our examination of the conventional wisdom is done in three stages. In the next section we analyze the demand side of the labor market—i.e., the changes in the skill requirements of jobs in the recent past (1973 to 1986) as well as those anticipated by the BLS's employment projections for the year 2000. We then turn to an analysis of the expected trends in labor supply—i.e., the quantity and quality of the future workforce. The section on wage and income trends broadens the inquiry to examine recent and expected trends in wages and incomes in order to assess whether future trends will remedy the labor market problems that emerged in the 1980s. We conclude with an examination of the policy implications of our analysis.

Demand: Trends in Skill Requirements

To know whether there will be a "skills mismatch" requires an assessment of the skills required for the jobs that one anticipates will be available. This section examines the changes in skill requirements implicit in BLS employment projections. However, to know whether the expected increase in skill requirements is "explosive," large, or just modest, one needs a yardstick. We will use the changes in skill requirements in the 1973 to 1986 period as our point of comparison.

Our conclusion is that skill requirements will rise in the 1990s due to shifts in the occupational structure, but at a modest rate that is significantly less than that of the 1973–1986 period. Moreover, there is no evidence that skill upgrading within particular occupations will be large.

Our conclusion is that skill requirements will rise in the 1990s due to shifts in the occupational structure, but at a modest rate that is significantly *less* than that of the 1973–1986 period. Moreover, there is no evidence that skill upgrading within particular occupations will be large, though it seems likely that more jobs will require threshold levels of literacy and numeracy. The implication of these findings is that there is little empirical support for one aspect of the "coming skills mismatch" hypothesis: an explosive growth in skill requirements.

Characterizing the Job Structure

To analyze the characteristics of jobs (their skill and pay levels), we classify changes in the job structure along three dimensions. First, job characteristics are partially driven by changes in the *occupational composition* of employment, such as a shift from manual to technical/professional jobs. Since jobs within a particular occupation will differ depending on their industry attachment, a second important dimension is the *industrial composition* of employment. The last dimension is changes in the *skill content or pay level* of work in a particular occupational/industrial category. This dimension reflects, for instance, the degree to which the skill level of supermarket cashiers, blue-collar manufacturing workers, or stock brokers grows over time. As it turns out, change in the *skill content* of particular jobs is probably the most important (certainly the hardest to measure) dimension of the job structure.

The three dimensions of the job structure are illustrated in Table 1, where the private economy is divided into two industrial sectors—goods production and service production—and four occupations—executive/technical/professional, clerical/sales, blue collar, and service. The skill requirements of jobs are proxied in this table by the educational level of the workers in the particular occupational/industrial category. Pay levels are also presented.

As demonstrated in Table 1, while professional/technical jobs require more education and provide higher pay than jobs in other occupations, the educational levels of occupations are roughly the same within each industrial sector. Because of a greater proportion of technical/professional jobs, the educational requirements of service sector jobs as a whole are somewhat higher (13 years versus 12.2 years).

TABLE 1
Pay and Education Level by Occupation and Industry, 1988

Occupation	Goods Producing	Service Producing	All Sectors
Executive, Technical, Professional			
Employment Share	4.1%	21.9%	26.0%
Hourly Compensation	$26.45	$22.16	$23.10
Mean Education (years)	14.7	14.9	14.8
Clerical/Sales			
Employment Share	3.4%	27.0%	30.4%
Hourly Compensation	$13.75	$11.46	$11.80
Mean Education (years)	13.0	13.0	13.0
Blue Collar			
Employment Share	16.1%	11.1%	27.2%
Hourly Compensation	$15.46	$12.82	$14.35
Mean Education (years)	11.4	11.7	11.5
Service			
Employment Share	0.3%	16.1%	16.4%
Hourly Compensation	$13.24	$7.01	$7.16
Mean Education (years)	10.9	11.5	11.5
All Occupations			
Employment Share	23.9%	76.1%	100.0%
Hourly Compensation	$17.21	$13.12	$14.28
Mean Education (years)	12.2	13.0	12.8

Source: Tabulations of Current Population Survey Earnings File (1988) for private nonagricultural wage and salary workers. Pay data from Employment Cost Index, March 1989.

However, regardless of occupation, goods production jobs pay much better than service production jobs. Consequently, shifts in both the *occupational* and *industrial* composition of jobs will affect skill requirements and pay levels. Interestingly, as we will stress below, a shift of jobs to occupations requiring more education, such as from blue collar to clerical/sales jobs, can lead to a *more* educated workforce that is paid *less* if the shift is also from goods to service production.

Finally, changes in the third dimension, *skill content*, should be considered as changes over time in the skill levels within the eight industrial/occupational categories.

We apply this framework in the remainder of this section to determine past and expected changes in skill requirements. First, we evaluate the relative importance of occupational and industrial employment shifts on pay levels and educational requirements. We then turn to a more detailed analysis of the effect of occupational change on seven different measures of skill as well as different measures of educational requirements. Last, we review the evidence on shifts in job content.

[T]here is little empirical support for one aspect of the "coming skills mismatch" hypothesis: an explosive growth in skill requirements.

Industrial Versus Occupational Shifts

Table 2 provides data which allow us to assess the relative importance of industrial shifts (e.g., the rising importance of services) and occupational shifts (e.g., the rising importance of white-collar professional/technical jobs). Specifically, the data show the effect of changes in the distribution of jobs among occupations and industries on hourly wages and compensation (wages and fringe benefits) and required educational levels in recent years, as well as the effects anticipated by BLS employment projections. For instance, changes in the industrial distribution of employment lowered hourly compensation between 1973 and 1979 by 0.99 percent which, in terms of a rate of change over ten years, is a decline of 1.65 percent.

Employment shifts toward low paying industries have lowered compensation more than the shift to higher paying occupations has raised compensation.

Several important conclusions regarding the effect of occupational and industrial mix on pay levels emerge from Table 2. In the past, employment shifts toward low paying industries have had an equal or more negative effect on overall compensation than the positive contribution of the shift to higher paying occupations.[5] An analysis of hourly wages (ignoring fringe benefits) would not capture this result because it would not take into account the fact that pay differentials between industries are *larger* for compensation than for wages and that pay differentials between occupations are *smaller* for compensation than for wages.

TABLE 2
Effect of Industry and Occupation Employment Shifts on Pay and Education, 1973–2000

			BLS Projections	
Pay and Education	1973–1979	1979–1986	1986–2000	1988–2000
		(Ten-Year Rates of Change)*		
		Industry Shift Effects		
Hourly Wages	−1.15%	−2.22%	−0.97%	−0.80%
Hourly Compensation	−1.65	−3.20	−1.42	−1.17
Education	0.45	0.55	0.27	0.24
		Occupation Shift Effects		
Hourly Wages	2.02%	2.74%	0.45%	0.56%
Hourly Compensation	1.67	2.18	0.24	0.37
Education	0.85	1.11	0.34	0.38

* The data have been converted to ten-year rates of change to facilitate comparisons of these time periods which are of different length: the change if the annual rate of change in these time periods had continued for ten years.

Source: Authors' calculations. See Appendix for details.

One startling conclusion is that the two BLS projections to the year 2000 show an extremely modest, if not inconsequential, effect of occupational shifts on hourly compensation, raising compensation by just 0.24 to 0.37 percent over a ten-year period. This positive contribution of the expected shift to higher paying occupations over 12 or 14 years is less than the *annual* decline of real hourly compensation for most workers in each year of the 1980s (e.g., real average hourly earnings fell 0.8 percent in 1989). Moreover, the negative consequences of the expected shift to low paying industries—a reduction of hourly compensation by 1.2 to 1.4 percent over the ten-year period—is three to five times larger than the positive benefits of expected occupational changes.

The two BLS projections to the year 2000 show an extremely modest, if not inconsequential, effect of occupational shifts on hourly compensation, raising compensation by just 0.24 to 0.37 percent over a ten-year period. . . which is less than the annual decline of real hourly compensation for most workers in each year of the 1980s.

These results allows us to put the findings of *Workforce 2000* in perspective. The analysis of changes in the job structure focused *solely* on occupational shifts and concluded that:

> . . . the jobs created between 1987 and 2000 will be substantially different from those in existence today. A number of jobs in the least-skilled job classes will disappear while high-skilled professions will grow rapidly. Overall, the skill mix of the economy will be moving rapidly upscale, with most new jobs demanding more education and higher levels of language, math, and reasoning skills (Johnston and Packer, 1987, p. 96).

A later section reviews in detail the anticipated change in skill requirements due to increased employment in "high-skilled professions" and other occupational changes. Here we can assess the effect of occupational changes on pay levels. Of overriding significance is that all of the changes described in *Workforce 2000* amount to an increase in overall compensation levels of less than 0.5 percent over 12 to 14 years; hardly a transformation of the job structure or a "rapid upscaling." Moreover, the expected occupational changes will have a smaller effect on the job structure over the next 12 to 14 years than the effect occupational changes have had in the past 13 years (roughly 0.4 percent versus 2.5 percent). Or, in other words, the "rapid upscaling" to "high-skilled professions" predicted in *Workforce 2000* will actually represent a *slowdown* in the wage effect of occupational upgrading.

Meanwhile, the *Workforce 2000* analysis ignores the more consequential shift to lower paying industries. The net result of the industrial and occupational employment shifts will be to *lower* pay levels. Equally critical, the *Workforce 2000* analysis ignores what has happened to average pay levels: the wages of most workers have declined in the 1980s. This issue will be analyzed in detail in the last section.

Table 3 provides further insight into recent compositional shifts by decomposing the "shift effects" into the underlying factors which drive them: the pay differences between expanding and shrinking occupations (or industries) and the rate at which employment is shifting between occupations (or industries). The larger the pay differences between expanding and shrinking units and the employment shifts between units, the greater the effect of any compositional shift on average pay will be.

TABLE 3
Pay Levels of Expanding and Shrinking Occupations and Industries

	1973–1979	1979–1986	BLS Projections 1986–2000	BLS Projections 1988–2000
	Pay in Expanding and Shrinking Industries			
Hourly Wages				
(1) Expanding	$ 9.71	$ 9.37	$ 8.98	$ 9.24
(2) Shrinking	11.35	11.72	11.19	11.35
(3) Ratio-((1)/(2))	0.799	0.799	0.803	0.814
Hourly Compensation				
(1) Expanding	$13.07	$12.42	$11.90	$12.25
(2) Shrinking	16.35	17.10	16.34	16.48
(3) Ratio-((1)/(2))	0.799	0.723	0.728	0.743
	Pay in Expanding and Shrinking Occupations			
Hourly Wages				
(1) Expanding	$12.11	$12.97	$ 9.86	$11.28
(2) Shrinking	8.21	8.90	8.31	9.15
(3) Ratio-((1)/(2))	1.48	1.46	1.19	1.23
Hourly Compensation				
(1) Expanding	$16.31	$17.35	$13.14	$15.11
(2) Shrinking	11.86	12.86	11.89	13.15
(3) Ratio-((1)/(2))	1.38	1.35	1.11	1.15
	*Ten-Year Rate of Compositional Shift**			
Industry Employment	7.7%	9.6%	4.4%	3.8%
Occupation Employment	5.4	7.0	3.2	2.7

* The rate of compositional shift is the shares of employment shifted among the occupations and industries, indicating for instance that shrinking industries lost × percentage points of employment to the expanding industries.

Source: Authors' calculations. See Appendix for details.

BLS projections imply a slowdown in occupational change and a shift to less upscale occupations.

This decomposition shows that the expected slowdown in the effect of occupational upgrading (shown in Table 2) is due to the fact that the BLS expects occupational shifting to occur at a slower rate than in 1973–1986 and because the pay differences between expanding and shrinking occupations are much smaller (1.11 or 1.15 versus 1.35 or 1.38) than in the past.[6] That is, the BLS projects a slowdown in the amount of change and the occupations to which the workforce is being "upscaled." On the other hand, the future industrial shift effects on pay levels are expected to be smaller than in recent years only because less shifting is expected and not because the industries to which employment is shifting are relatively better paying.

In contrast to our results for pay levels, the effect of both industrial and occupational employment shifts has been to raise educational levels (revisiting Table 2). However, the effects are rather small. Even the largest rate of change found in the table (for occupational shifts in the 1979–1986 period) implies raising the average educational attainment over ten years from the

1988 average of 12.76 years to just 12.90 years in 1998. The projected shift in the occupational employment mix necessitates an even smaller increase in educational requirements, a rise of just 0.04 extra years of schooling over ten years. This increase in educational levels can be accomplished if those entering the labor force have on average one-fourth of a grade level more education than those retiring from the labor force.

These results point out the disjuncture between changing educational requirements and pay levels. As we have seen, changes in the composition of jobs continue to lead to jobs which demand more educated workers but pay less. This is the consequence of the fact that skills are not rewarded equally in all parts of the economy and that workers in some sectors—particularly manufacturing—earn industry "premiums" or "rents" (Dickens and Lang, 1988; Katz and Summers, 1989). Howell and Wolff (forthcoming) show that the correlation between earnings and skill or educational levels is particularly weak for production and nonsupervisory workers (over 80 percent of all workers).

The projected shift in the occupational employment mix necessitates a small shift in educational requirements that can be accomplished if those entering the labor force have on average one-fourth of a grade level more education than those retiring from the labor force.

Given this disjuncture between pay and skill levels, one should be cautious about studies which ignore wage trends and focus solely on skill trends and then conclude, as does *Workforce 2000*, that jobs of the future will be far "better" than current jobs. After all, most workers are at least equally concerned about their pay on the job as about the skills required of them. For this reason, we will use the last section to examine trends in incomes and wages.

We now turn to an examination of the effect of occupational employment shifts on educational and skill requirements.

The Effect of Occupational Shifts on Skill and Educational Requirements

The preceding section suggests the wisdom of considering both industrial and occupational shifts when analyzing the effects of structural change. In this section, however, we will restrict our analysis of structural change to the effects of shifts in the occupational structure. We do this so that we may directly confront the most commonly cited evidence in favor of massive upskilling of the job structure. This evidence, coming from BLS analyses of occupational change (especially the *Workforce 2000* report) is entirely about occupational shifts. Thus, we too, confine our analysis to occupational shifts and show that, even on this relatively favorable terrain, the claims of the conventional wisdom do not hold up.

Perhaps the most widely cited data on job upskilling are the following from the *Workforce 2000* report. While only 22 percent of jobs in 1984 (the base year used in the report) required a college degree, 30 percent of the new jobs created between 1984 and 2000 will require such a level of education.[7] The same trend is observed by looking at direct job-skill requirements in the language, math, and reasoning areas.[8] The new jobs in the fast-

est growing occupations have the highest skill ratings in all three areas, while those in slow growing occupations have medium skill ratings, and jobs lost in declining occupations have quite low skill ratings (*Workforce 2000*, p. 99, Tables 3–9). And, averaging across skill areas, 41 percent of new jobs will be in the three highest skill categories, compared to only 24 percent in such categories today (*Workforce 2000*, p. 99).

[The data underlying the Workforce 2000 analysis show that] the average skill score is projected to rise to only 3.17 by the year 2000. This is an increase of just 0.11, or 3.6 percent over the sixteen-year period, hardly a massive upgrading of job skills.

There are two key problems with these data. First, since information is provided on only particular parts of the job structure (i.e., new jobs, fastest growing occupations), there is no way to predict the impact of this future job upskilling. Second, since no historical yardstick is provided, it is difficult to judge whether this expected increase in job skills will be large, modest, or of little consequence.

Consider, for example, the data provided above on the skill and educational requirements of "new" jobs (i.e., the net additions to the job structure). They seem impressive but, by themselves, they do not tell us whether the job structure as a whole will be substantially upskilled. *This depends on the relative weight of these new jobs within the overall job structure.* To find information on this issue, we are forced to turn to the technical appendix in the *Workforce 2000* report (Jaffe, 1987), which was not distributed with the original report and is not widely available.

Results based on information from this technical appendix are shown in Table 4. These data show that the average level for language skills (General Educational Development-Language or GED-L) in 1984 was 3.06, about the middle of the scale for that item. However, despite the relatively high skill levels of many of the new jobs, the average skill score is projected to rise to only 3.17 by the year 2000. This is an increase of just 0.11, or 3.6 percent over the sixteen-year period, hardly a massive upgrading of job skills. Looked at on an annual change basis, in fact, this works out to an increase of only about 0.2 percent per year. Thus, while the Hudson Institute figures do indicate some increase in skill requirements in the future, this increase will be quite modest and occur very slowly.

At least three reasons for this rather modest increase can be identified. The first is that the *amount* of shifting taking place in the occupational structure is not very high. As shown in Table 4, when we look at all the occupations which are increasing their *share* of employment (which is how shifting takes place), the total increase in these occupations' share of employment is just under six percentage points, balanced by the six percentage point loss suffered by decreasing-share occupations. In other words, if we think of the U.S. as an economy with 100 jobs, after the end of 16 years, six people will have moved out of the decreasing-share occupations (which are relatively low-skill) into the increasing-share occupations (which are relatively high-skill). Considering the length of time involved, this amount of shifting is hardly overwhelming.

TABLE 4
Analysis of *Workforce 2000* Data

			Change, 1984–2000	
	1984	2000	Amount	Percent
Employment (millions)	105.0	131.0	26.0	24.8%
Average GED-L	3.06	3.17	0.11	3.6%

Occupational Analysis[1]

	Number of Occupations	Change in: Employment	Average Share	GED-L
1. **By Change in Employment Level**				
a. Increasing	20	27.2		3.6
b. Decreasing	5	−1.2		1.9
2. **By Change in Employment Share**				
a. Increasing	13	20.9	+5.96	3.9
b. Decreasing	12	5.0	−5.96%	2.0

[1] The *Workforce 2000* analysis is based on 25 occupational *groups* aggregated up from a detailed occupational classification used by BLS in its projections which, in turn, is based on the classification used in the Occupational Employment Statistics (OES) survey.

Source: Authors' calculations based on Jaffe (1987), Table 17.

Second, while the most highly skilled occupational groups are generally the fastest growing, the weight of these groups within the job structure as a whole is relatively small. For example, the data in the *Workforce 2000* technical appendix show that the five most highly skilled occupational groups (which include the three fastest growing groups) will provide just 10.6 percent of the new jobs added to the economy between 1984 and 2000 and, even by the year 2000, will constitute only 6.1 percent of the job pool. Thus, the shift toward highly skilled jobs is not massive.

[T]he five most highly skilled occupational groups will provide just 10.6 percent of the new jobs added to the economy between 1984 and 2000 and, even by the year 2000, will constitute only 6.1 percent of the job pool. Thus, the shift toward highly skilled jobs is not massive.

Finally, the trend toward relatively high-skill jobs has by no means been uniform. In fact, it has been partially counterbalanced by a shift toward relatively low-skill jobs. For example, it is the service occupations, dominated by low-skill occupations such as cooks, waiters, household workers, janitors, security guards, and the like that will make the *largest* contribution to total employment growth between 1984 and 2000. By itself, this occupational group will provide almost one-quarter (23 percent) of the new jobs added to the economy in the sixteen-year period and constitute 16.8 percent of the overall job pool in the year 2000. The growth of this occupational group will actually make a negative contribution to overall skill level growth since the average language skill rating (GED-L) for this group is 2.6, substantially below the 3.1 average for the overall job structure in 1984, and the group will grow faster than average.

Without an historical comparison—absent from both the BLS and Workforce 2000 analyses—it is impossible to know whether the amount of future upgrading is greater, the same, or even less than in the past.

The argument presented above suggests that meaningful assessments of skill upgrading depend on taking all the various relevant factors into account (i.e., the total amount of shifting, the relative weight of fast-growing, high-skill occupations, countervailing growth trends among low-skill occupations, etc.). Therefore, skill upgrading cannot be assumed to be high simply because high-skill occupations are generally growing faster than low-skill occupations. The weaknesses of such an approach are further illustrated by the following data from a recent Bureau of Labor Statistics article (see Table 5), data which are said to suggest significant educational upgrading of the job structure. These data are presumably the basis for the statements by BLS spokespeople that there will be "vast changes in the skills that will be required for the jobs of the future" and "[O]ur projections also suggest that the fastest growing jobs will be those which require a considerable amount of technical, professional, and managerial training. It seems clear that we may indeed face an economy in the future that will have special needs for workers with skill and training."[9]

This table indeed suggests that there is some educational upgrading going on. *But there is no way of telling from these data how substantial this upgrading is because no quantification was attempted nor any yardstick applied.* For example, these data were not used to produce weighted averages of educational attainment in each year, to give a sense of how much upgrading is expected to take place relative to recent historical experience.

TABLE 5
Employment Shares in Broad Occupational Clusters by Level of Educational Attainment, 1986–2000, Moderate Alternative

Occupational Cluster	1986	2000	Change 1986–2000
Total	100.0%	100.0%	
Group I[1] (High Education)	25.1	27.3	+2.2
Group II[2] (Medium Education)	40.8	40.0	−0.8
Group III[3] (Low Education)	34.0	32.7	−1.3

[1] Includes: management and management-related occupations; engineers, architects, and surveyors; natural scientists and computer specialists; teachers, librarians, and counselors; health diagnosing and treating; other professional specialists; and technicians.
[2] Includes: salesworkers; administrative support, including clerical; blue collar worker supervisors; construction trades and extractive workers; mechanics and repairers; and precision production and plant systems workers.
[3] Includes: service workers; agriculture, forestry, and fishing workers; machine setters and operators; hand workers, transportation, and material moving workers; and helpers and laborers.

Source: Silvestri and Lukaciewicz (1989), Table 8.

The data presented previously (see Tables 2 and 4) suggest that projected occupational shifts in the job structure appear likely to produce only modest increases in job-skill requirements. This is reason enough to be skeptical of the conventional wisdom on occupational upgrading. But, as we emphasize repeatedly in this report, it is necessary to have a point of historical comparison when assessing structural trends. Without such a yardstick—absent from both the BLS and *Workforce 2000* analyses—it is impossible to know whether the amount of upgrading is greater, the same, or even less than in the past. As we show later in this section, the use of a historical yardstick has a very large effect on interpretations of projected skill changes.

[R]esearch shows that while job-skill upgrading took place in each decade (1960–1970, 1970–1980, 1980–1985), the rate of increase declined substantially over time.

To understand the historical background of changes in job-skill levels, we first present data from an important recent study by D. R. Howell and E. N. Wolff (forthcoming) on skill changes in the U.S. economy between 1960–1985. Their study looks thoroughly at the influence of both industrial and occupational shifts on skill levels during this period, using a job structure matrix of 267 occupations and 64 industries. One of the critical findings from this research was that, while structural upgrading of job-skill levels took place in each decade (1960–1970, 1970–1980, 1980–1985), *the rate of increase declined substantially over time*. For example, the "substantive complexity" of jobs went up 0.69 percent per year in the sixties, 0.46 percent per year in the seventies, and only 0.28 percent per year in the eighties (see Table 6), split about evenly in each decade between occupational and industrial shift effects.[10] These results hardly suggest an impending explosion of skill upgrading due to structural change.

TABLE 6
The Effect of Industry and Occupation Employment Shifts on Substantive Complexity of Jobs, 1960–1985

Time Period	Annual Rate of Change (*percent*)	Ten-Year Rate of Change* (*percent*)	Industry Component (*percent*)	Occupation Component (*percent*)
1960–1970	0.69%	7.1%	55.2%	44.8%
1970–1980	0.46	4.7	44.6	55.4
1980–1985	0.28	2.8	49.9	50.1

* The data have been converted to ten-year rates of change to facilitate comparisons of these time periods which are of different length: the change if the annual rate of change in these time periods had continued for ten years.

Source: Howell and Wolff (forthcoming, April 1991), Tables 3 and 8.

McGranahan and Ghelfi (forthcoming) also investigate the recent (1970–1988) effects of industrial and occupational shifts on skill levels of jobs (though using educational attainment, rather than DOT scores, to measure skill). They also find a slowdown in skill upgrading from these shifts over time.

Based on recent historical trends, then, one would expect the amount of occupational upgrading in the 1990s to be *less* than that in the 1970s and 1980s, rather than more. This expectation was confirmed by our comparison of historical changes in skill levels (1973–1986) with projected future changes in skill levels (1986–2000 and 1988–2000), presented in Table 7.[11] To ensure that we would not miss any possible evidence of an explosion in skill requirements, we looked at a very wide range of skill measures: seven direct measures of skill from the Dictionary of Occupational Titles (DOT), the proxy skill measure of years of schooling required, as well as the level of education required, using four different educational categories.

These data show clearly that not only is the effect of future occupational shifts on skill levels likely to be modest, but also that this effect will be smaller than in previous time periods.

These data show clearly that not only is the effect of future occupational shifts on skill levels likely to be modest, but also that this effect will be smaller than in previous time periods. That is, when the 1973–79 or 1979–1986 change rates are compared to the projected change rates for 1986–2000 and 1988–2000, the future change rates are typically around one-third to one-quarter of the historical rates. For example, skill levels in data handling went up at a ten-year rate of 4.01 percent between 1973 and 1979 and a rate of 5.07 percent between 1979 and 1986, but are projected to rise in the future at rates only about one-third the 1973–79 rate and just one-quarter the 1979–1986 rate.

The patterning is similar for the other skills, though the rates of change are uniformly more modest than for handling data. (The one exception is for handling things, a physically-oriented skill whose 1973–79 rate of change was actually slower than projected future rates of change. But here skill levels are going down, rather than up.) We see modest rates of change in the latter part of the 1970s, a slight acceleration in the first part of the 1980s (in contrast to Howell and Wolff, who observed a continued slowdown[12]), and then dramatically smaller projected rates of change from the late 1980s to the year 2000. The trend line in these data flatly contradicts the popular notion that occupational upgrading will produce a future explosion in job-skill requirements.[13]

Further insight into the future slowdown in occupational upgrading may be gained from the data in Table 8. These data, for the historical periods 1973–79 and 1979–1986 and the 1986–2000 and 1988–2000 projections, compare the skill and educational requirements of expanding occupations to the requirements for shrinking occupations. While, as we would expect, skill/educational requirements in expanding occupations are higher in all time periods than requirements for shrinking occupations, *the skill gap between expanding and shrinking occupations is projected to narrow in the future.*[14]

For example, in the 1973–79 period, the data handling skill requirements of expanding occupations were 3.57 on a six-point scale, compared to only 1.16 for declining occupations. This meant that data handling requirements were over three times as high for expanding as declining occupations in this time period. Similarly, in the 1979–1986 period, data handling requirements were two and one-half times higher in expanding occupations than in shrinking ones.

In contrast, the projections show much smaller gaps between expanding and shrinking occupations in the future. For 1986–2000, the data handling requirements for expanding occupations are 3.37, compared to 2.28 for declining occupations, producing a ratio of only about 1.5. The analogous figures for 1988–2000 produce a somewhat higher ratio (1.82), but one that is still considerably below the ratios in the preceding time periods. The data for the other characteristics tell a similar story: the gap is projected to narrow between the skill requirements of expanding and shrinking occupations.

[T]he skill gap between expanding and shrinking occupations is projected to narrow in the future.

The last line of Table 8 shows the other reason for slower occupational upgrading in the future. Not only will the skill gap narrow between expanding and shrinking occupations, but the actual amount of shifting going on between expanding and shrinking occupations will decline. Together, these two factors dictate the slower future pace for occupational upgrading that we observed in Table 7.

The data in Tables 7 and 8 tell a clear story about the extent of projected future skill change. But it could still be objected that BLS projections tend to underestimate the amount and type of occupational shifting taking place (see Bishop and Carter, 1990), and therefore that skill change estimates based on these projections will be biased downward. There is some evidence that recent BLS projections, particularly in the first part of the 1980s, did evidence this tendency.

However, in relation to the data presented in Tables 7 and 8, two considerations lessen our concern with this potential problem. First, the most serious BLS underestimates pertain to the first part of the 1980s, when the worsening of the trade deficit took its toll and occupational trends were skewed by the loss of large numbers of blue collar jobs. This suggests that relatively unusual events were responsible for some of this underestimate. In fact, BLS projection estimates for the latter part of the 1980s, though still underestimates, have turned out to be substantially closer to observed trends in the occupational structure.

TABLE 7
The Effect of Occupation Employment Shifts on Skill and Education Requirements, 1973–2000

			BLS Projections	
	1973–1979	1979–1986	1986–2000	1988–2000
	(Ten-Year Rates of Change*)			
Skill Indices				
Handling Data	4.01%	5.07%	1.24%	1.31%
Verbal Aptitude	2.19	2.65	0.66	0.72
Length of Training (SVP)	2.13	2.38	0.53	0.59
Intellectual Aptitude	2.02	2.35	0.55	0.63
General Educational Development (GED)	1.91	2.35	0.60	0.65
Handling People	1.71	2.45	0.72	0.72
Handling Things	−0.57	−2.08	−0.87	−0.68
Education				
Median Years Required	0.85	1.11	0.34	0.38
	(Percentage Point Change*)			
Shares of Employment Requiring:				
Less than High School	−1.42%	−1.51%	−0.31%	−0.37%
High School Graduate	−0.92	−1.51	−0.55	−0.55
Some College	0.57	0.59	0.11	0.13
College Graduate or More	1.77	2.46	0.74	0.79

* The data have been converted to ten-year rates of change to facilitate comparisons of these time periods which are of different length: the change if the annual rate of change in these time periods had continued for ten years.

Source: Authors' calculations. See Appendix for details.

[E]ven Bishop and Carter's dramatically optimistic projections do not support the Workforce 2000 notion of a future "skills explosion."

Second, even granting that BLS projections for the 1990s may be prone to some underestimation of change in the occupational structure, this underestimate would have to be massive indeed to change the basic scenario presented here. In fact, given that the rates of skill upgrading shown in Table 7 are one-third to one-fourth of those estimated for the recent past, the amount of structural change shown by "improved" BLS projections would have to be three or four times as great as in the official projections simply to generate skill upgrading at historical rates (which were actually fairly modest). This suggests that substantial skill upgrading from occupational shifts is unlikely, even if the BLS estimates are fairly far off.

To test this assessment, we calculated the skill upgrading implicit in Bishop and Carter's "most preferred" projection scenario (see Table 12, column 7). The result: rather than the substantial deceleration suggested by the BLS projections, the amount of skill change suggested by their "most preferred" scenario still represents a modest slowdown compared to previous decades.[15] Thus, even Bishop and Carter's dramatically optimistic projections do not support the *Workforce 2000* notion of a future "skills explosion."

TABLE 8
Skill and Education Requirements of Expanding and Shrinking Occupations, 1973–2000

Skill Indices	1973–1979	1979–1986	BLS Projections 1986–2000	BLS Projections 1988–2000
Handling Data *(0-6 scale)*				
(1) Expanding	3.57	3.75	3.37	3.31
(2) Shrinking	1.16	1.47	2.28	1.82
(3) Ratio-((1)/(2))	3.08	2.55	1.48	1.82
Specific Vocational Preparation (SVP) *(1-9 scale)*				
(1) Expanding	5.80	5.94	5.04	5.62
(2) Shrinking	3.77	4.17	4.17	4.49
(3) Ratio-((1)/(2))	1.54	1.42	1.21	1.25
Verbal Aptitude *(1-5 scale)*				
(1) Expanding	3.50	3.55	3.45	3.35
(2) Shrinking	2.31	2.45	2.94	2.59
(3) Ratio-((1)/(2))	1.52	1.45	1.17	1.29
General Educational Development (GED) *(1-6 scale)*				
(1) Expanding	4.17	4.22	3.65	4.03
(2) Shrinking	2.87	2.99	2.96	3.14
(3) Ratio-((1)/(2))	1.45	1.41	1.23	1.28
Education				
College Graduate or More Required *(percent)*				
(1) Expanding	37.0%	39.7%	27.9%	34.6%
(2) Shrinking	3.9	4.7	6.1	5.7
(3) Ratio-((1)/(2))	9.49	8.45	4.57	6.07
Some College Required *(percent)*				
(1) Expanding	22.8%	22.6%	20.4%	21.0%
(2) Shrinking	12.4	14.2	16.9	16.5
(3) Ratio-((1)/(2))	1.84	1.59	1.21	1.27
Median Education *(years)*				
(1) Expanding	14.4	14.5	13.0	14.3
(2) Shrinking	12.3	12.4	11.5	12.4
(3) Ratio-((1)/(2))	1.17	1.17	1.13	1.15
Rate of Occupational Shift *(percent)*				
Ten-Year Rate*	5.4%	7.0%	3.2%	2.7%

* See Table 3.

Source: Authors' calculations. See Appendix for details.

In summary, contrary to the conventional wisdom, the data presented in this section show that the move to a "service economy" will not automatically produce a highly skilled job structure. This is because occupational upgrading trends are not large enough to generate a substantial rise in job-skill levels. Furthermore, projected rates of occupational upgrading actually appear to represent a slowdown from upgrading trends in the past, trends that were themselves fairly modest. Thus, if previous growth in the service economy has not already produced a highly skilled job structure, future growth by itself is even less likely to do so.

The move to a "service economy" will not automatically produce a highly skilled job structure. . . because occupational upgrading trends are not large enough to generate a substantial rise in job-skill levels.

The Effect of Content Shifts Within Jobs on Skill Requirements

So is all the talk of substantial skill upgrading in the economy just that—talk? Not necessarily. What we have documented above is that *structural* change—distributional shifts in the industrial and occupational composition of employment—has not, and most likely will not, produce substantial upgrading.[16] However, distributional changes are not the only way that skill levels can rise in the economy.

As we discussed earlier, the other way is through changes *within* occupations; that is, changes in the *content* of task performance for a given type of job. For example, if computers are now employed extensively within an occupation where they weren't used at all 15 years ago, than the average skill level in that occupation may have changed dramatically over the fifteen-year period. If the number and magnitude of these within-occupation (content) changes are sufficiently high, then substantial skill upgrading can be taking place within the economy, even while the effects of structural (distributional) changes are modest.

The problem is that we don't know the amount of content change that has taken place in the recent past, nor do we have a clear idea of how much is likely to take place in the future. One reason is that, while surveys like the decennial Census, Occupational Employment Statistics (OES) survey, and the Current Population Survey (CPS) allow us to keep careful track of changes in industrial/occupational distributions, changes in job content are not monitored as closely. For example, while the CPS is done monthly and the OES is conducted on a three-year cycle, there has not been a new edition of the DOT—the only survey that tracks job content—since 1977. This and other data problems (detailed in Spenner, 1988; Teixeira and Swaim, forthcoming) make it virtually impossible to track content change accurately at the economy-wide level (as we did with structural change).

Nor does the case study literature provide us with a clear window onto the direction and magnitude of within-occupation change. It does not tell us, for example, that where technological changes within occupations have been large, there have been substantial rises in skill levels; a relationship which, if true, would allow us to make some reasonable inferences about past and future content change.

On the contrary, the message of this literature on technological change might be summarized as: *it depends* (Spenner, 1988; Bailey, 1989). There is no necessary relationship between technological progress and skill upgrading. The change in employment patterns due to a given technology can vary from large increases in skill levels to small increases to none at all or even *downgrading*. For example, Jaikumar's (1986) cross-national study of flexible manufacturing systems shows essentially similar technologies being deployed in a variety of ways in different countries.

The above suggests that the magnitude of recent job content change cannot be estimated with much precision and that we should be cautious in assessing the future direction of content change. Nevertheless, we believe that areas of overlap between three sources of information—the scholarly literature, journalistic accounts, and the accumulating testimony of the nation's business community—allow some limited conclusions to be drawn.

Jobs today are more likely to require at least threshold levels of literacy and numeracy. . . [S]ome jobs in "best practice" firms are being substantially upgraded . . . however, these "best practice" firms are not the norm in the U.S. economy today.

First, jobs today are more likely to require at least threshold levels of literacy and numeracy (i.e., some facility with reading and simple arithmetic computation). However, that is information technology being applied, and as we have emphasized, there is no predetermined level at which this technology must be applied. Employers find it difficult to use workers who lack these threshold skills and view these skills as a necessary condition for flexible use of employees (i.e., retraining) in work situations.

Second, some jobs in "best practice" firms within certain industries (i.e., banking, insurance, textiles, apparel, metalworking, etc.) are being substantially upgraded. In these firms, jobs are being restructured so that workers are expected to independently solve technical problems that come up in the course of their work, to learn new tasks on a fairly regular basis, and to interact extensively with fellow workers, frequently as part of a "team." This requires a set of skills that goes considerably beyond simple, threshold levels of literacy and numeracy.[17]

Third, "best practice" firms that are upgrading job skills to this relatively high level are not the norm in the U.S. economy today, though they are becoming numerically more important over time (see Commission on the Skills of the American Workforce, 1990). That they are not numerically dominant at the present time suggests that the upgrading response is only one possible response to a set of factors—the spur of international competition, the rise of new types of markets that call for "flexible production," and the need to institutionalize responsiveness to rapid technological change (Bailey, 1989)—that characterize the current business environment. Other firms are responding to the same set of factors by altering production in ways that leave job structures intact or even by "dumbing down" new technologies so they can be adapted to existing managerial practices and the perceived quality of the workforce.

We are aware that some leading researchers believe that substantial skill upgrading within jobs is generalizable beyond "best practice" firms. This, for example, is Bailey's (1989) conclusion in his case study-based report on changes in skill requirements. While Bailey correctly focuses on content changes within jobs as the most important aspect of changes in skill requirements and provides convincing data on changing skill requirements within certain firms, we do not believe his data justify an assertion of substantial, generalized content shifts.[18] In fact, given that his sample is relatively small and selective (i.e., of progressive or "leading" firms), these data seem more supportive of a "best practice" interpretation than a broader, economy-wide judgement.

Only 5 percent of American employers believe educational and skill requirements are rising significantly, while 80 percent say their primary concern is finding employees with a good work ethic and appropriate social behavior.

If the "best practice" interpretation is accurate, much of the current talk about extensive job upgrading appears to represent a considerable exaggeration of the limited upgrading actually happening in contemporary workplaces. This viewpoint is corroborated by findings from a survey of employers conducted by the Commission on the Skills of the American Workforce. According to this survey, only 5 percent of American employers believe educational and skill requirements are rising significantly, while 80 percent say their primary concern is finding employees with a good work ethic and appropriate social behavior. This suggests that the amount of skill upgrading going on is indeed overestimated.

What accounts for this exaggeration? In our view, much of it is wishful thinking, and what is desirable is confused with what exists. People who are aware of the potential of new information technologies and of the ways this potential is being tapped within workplaces by our economic competitors view this as desirable, and assume that U.S. firms must be moving down the same path. But the realities of technological adaptation, as we explained above, are much more complicated.

Assessing Demand-Side Changes

Overall, the evidence presented here suggests that there may be a problem with an upskilling of the job structure, but not the problem people generally think of. It is not that there has been (or will be) so much upgrading of the occupational distribution, or even that within-job upgrading has become so extensive, but rather that the job structure is changing rather slowly and irregularly. In sum, there may not be *too much* upskilling of the job structure, but rather *too little*. Put another way, there may be more of a *potential* for upskilling than *actual* upskilling.

Whether this problem will continue into the future hinges on managerial strategies, market pressures, workforce quality, public policy initiatives, and other factors that will structure the organization and deployment of technology by firms. This suggests that, if a highly skilled job structure is desired for competitive or other reasons, it may be necessary for business, government, and labor to consciously foster one. As we have demonstrated in the last two sections, the growth of the "service economy," by itself, is very unlikely to produce such an outcome.

Our conclusion that, absent concerted action to encourage such a trend, skill requirements are unlikely to rise rapidly in the next decade may seem inconsistent with observed trends in the economic returns to education in the 1980s. A number of analysts have argued that, since the economic returns to education rapidly escalated in the 1980s, the market is signalling an increased demand for highly skilled workers and, hence, a rapid increase in job-skill requirements (see, for example, Bound and Johnson, 1989; Burtless, 1990; and Blackburn, Bloom, and Freeman, 1990). By this logic, the explosion of job-skill requirements is already here and the only question is the extent to which this trend will continue in the future.

There may not be too much upskilling of the job structure, but rather too little. Put another way, there may be more of a potential for upskilling than actual upskilling.

The data on increasing relative returns to education—which simply means that the wages of more educated workers (e.g., college graduates) have increased relative to that of less educated workers (e.g., high school graduates)—are not in dispute. All observers agree there has been a substantial increase in the wage gap between more- and less-educated workers in the 1980s. But the assumed link between these data and increases in *average* skill requirements is open to question.

To begin with, there is a disjuncture between skill and pay (see the discussion in "Industrial versus Occupational Shifts"), so jobs at the same skill level are rewarded differently in different parts of the economy. This means that changes in the overall relative rewards for skill (i.e., in the returns to education) are intrinsically an ambiguous indicator of changes in job-skill requirements. As such, one must examine the underlying determinants of the rise in earnings differentials before any causal link to skill changes can be made.

Furthermore, even assuming that pay reflects skill, returns to education are a *relative* indicator and therefore bear no necessary relationship to overall changes in skill requirements. For example, a substantial downskilling of the bottom half of the job structure would presumably *increase* the returns to education (since the wages of workers with little education would decrease relative to well-educated workers), while also producing an overall *decrease* in job-skill requirements. Thus, an increase in returns to education cannot logically be equated with an upskilling of the job structure.

Finally, available data suggest that the story behind increasing returns to education in the 1980s is, in fact, considerably more complicated than a simple increase in job-skill requirements. Looking first at the descriptive level, the relative returns to education increased in the 1980s primarily because of declining wages for the less educated, not because of increasing wages for the more educated. For example, Katz (1990) found that, from 1979 to 1987, the wages of young male high school graduates declined dramatically (− 20 percent), while the wages of young male college graduates went up relatively modestly (+ 11 percent). Thus, about two-thirds (20/31) of the increased wage gap between the two groups is attributable to the fall in wages among the noncollege-educated.

Similarly, Juhn, Murphy, and Pierce (1989) found that the bottom 40 percent of male high school graduates earn from 14 to 18 percent less than comparable workers in 1963, while only the top fourth have gained in real terms. Under the assumption that wages reflect job-skill levels, the fact that wages for noncollege graduates have fallen so dramatically could even be viewed as evidence for a shift to *lower* skill requirements for a large segment of the workforce (three-quarters of young male workers have not completed college; over 50 percent have no more than a high school education). This is not to say that such a broad deskilling has taken place, but simply to emphasize that, on closer scrutiny, the wider pay gap between educational groups is susceptible to a wide variety of interpretations.

Examination of possible factors driving the increasing returns to education in the 1980s further suggests that rising job-skill requirements may only be one of a multiplicity of causes for this phenomenon.

Moving beyond the descriptive level, examination of possible factors driving the increasing returns to education in the 1980s further suggests that rising job-skill requirements may only be one of a multiplicity of causes for this phenomenon. This can be seen most clearly by looking at young (25–34) white males and at the earnings differential between college graduates and high school graduates (only 10 percent of this group has not completed high school). It makes sense to focus on young male workers since: (1) this group has experienced the most dramatic escalation in the returns to education in the 1980s; and (2) this group is also likely to have been hit particularly hard by skill requirement growth, if such growth has taken place. A meticulous decomposition of factors affecting returns to education for this group shows the following (Blackburn et al., 1990):

(A) The key labor market difference between the 1970s and 1980s for this group was the *deceleration* in the growth of the relative supply of college-educated workers. In fact, the growth in college-educated workers in the 1970s was so fast that it actually *drove down* the returns to education in that decade. Blackburn et al. found that about one-quarter of the increased returns to education in the 1980s can be accounted for by a decline in the relative supply of college-educated workers, allowing returns to education to "bounce back" from the depressed levels of the 1970s.

(B) Another quarter of the increased earnings differential between college and high school graduates can be accounted for by industrial shifts in the pattern of employment for each group. There is no *a priori* reason to associate these industrial shifts with higher pay for college graduates, due to higher skill requirements in certain industries. Indeed, it seems at least as reasonable (if not more so) to suppose that employment shifts toward lower paying industries among high school graduates are implicated. In this instance, loss of industry premiums would appear to reflect a *loss* of industry-specific skills or a loss of pure rents, rather than a shift to higher skill requirements.

(C) Finally, the decline in unionization accounts for another quarter of the increased earnings differential between college and high school graduates in the 1980s.

All together, then, factors bearing no clear relationship to rising skill requirements account for three-quarters of the increasing returns to education in the 1980s. This leaves one-quarter of the increased earnings differential that could conceivably be ascribed to increased skill requirements driving up the relative demand for college graduates.

Even here, we believe that other factors besides rising skill requirements should not be ruled out. These include employment shifts to smaller firms through subcontracting; increased use of contingent workers; wage concession bargaining; and even downskilling of work for the less-educated.

Factors besides rising skill requirements should not be ruled out as explanations of rising returns to education. These include: employment shifts to smaller firms through subcontracting; increased use of contingent workers; wage concession bargaining; and even downskilling of work for the less-educated.

At this point, it should be noted that Blackburn et al. performed the same decomposition for white men, aged 25–64, and were unsuccessful in explaining any of the increase in earnings differential for this group, making the unexplained residual much larger (though the *magnitude* of the increased differential was much less to begin with). We do not believe, however, that the size of the residual for this group can be taken as proof for the rising skill requirements thesis. More direct evidence is needed to sustain such an interpretation, especially since it fails to hold up for the 25–34 age group, where it should logically apply.[19]

Despite this objection and others we have raised, we do believe that some part of the unexplained residual for young male workers can be reasonably ascribed to rising skill requirements. But this fraction of a residual is hardly enough to justify talk of a dramatic rise in skill requirements. In fact, results on this level seem quite consistent with the analysis offered in this report, which suggests relatively modest recent growth in skill requirements.

Supply: Changes in Labor Force Growth and Composition

The argument addressed in the first part of this paper is essentially a *demand* side argument; i.e., that the demand for skills is rising dramatically due to changes in the job structure. As we have seen, substantial demand increases are much less certain than suggested by the conventional wisdom, and will not follow automatically from structural change in the economy.

The assumption that, given slow labor force growth, the necessary result will be tight labor markets, with resulting low unemployment rates and upward pressure on wages, is flawed.

But the other side of the conventional wisdom is a *supply* side argument, now also widely accepted by the media and policymakers. This argument centers on the idea of a "labor shortage," a shortage that is said to have two dimensions. The first dimension is an *aggregate* labor shortage that will supposedly create tight labor market conditions in the 1990s. The second dimension is a specific shortage of workers with adequate levels of skills and education, which will produce a *skills mismatch* between available jobs and available workers.

Changes in Labor Force Growth

This section deals with the first claim—that an aggregate labor shortage will be created by a slow-growing labor force in the 1990s. The argument here is that slow population growth will result in slow labor force growth which, in turn, will tighten labor markets, forcing employers to raise wages, reach farther down in the labor queue, and/or invest in labor-saving technology. This argument may seem particularly at odds with reality given the current economic downturn. Nevertheless, even if the recession lasts several years, there may still be a long-term effect of slow population and labor force growth on future unemployment rates.

The first part of this argument, that slow population growth will result in a slow-growing labor force, is by itself relatively unobjectionable. Population growth projections do suggest that the labor force will grow quite slowly in the 1990s. The latest BLS projections suggest an annual growth rate of a little over 1 percent, compared to almost 3 percent in the 1970s.

However, it should be noted that, even here, there are some grounds for uncertainty. Immigration levels are notoriously difficult to assess and predict, so it is possible that immigration levels may exceed current estimates for the 1990s. For instance, the National Planning Association's estimates of future immigration flows run 50 to 130 percent greater than those projected by BLS (see Belous, 1990). This difference in immigration estimates suggests that the labor force may grow 15 to 40 percent faster than the BLS is currently projecting.

The next part of the argument is more obviously flawed. This is the assumption that, given slow labor force growth, the necessary result will be tight labor markets, with resulting low unemployment rates and upward pressure on wages.[20] One obvious problem here is that slow labor force and population growth should also slow the growth in demand for goods and services (barring an export-led boom), which in turn, slows the growth in demand for workers. Thus, while slow labor force growth could conceivably be associated with tight labor markets, it is by no means a logical consequence of such slow growth. Tight labor markets, in reality, depend on a number of different factors (for example, productivity) with no one-to-one relationship to labor force growth rates. (It is worth noting that a recent article by a BLS economist (Sargent, 1988) also states that an aggregate labor shortage in the 1990s is unlikely.)

Given this, it comes as no great surprise that the slow labor force growth/tight labor markets connection is not borne out by recent data from advanced industrial countries. These data, displayed in Table 9, clearly show that slow labor force growth cannot be counted on to tighten up labor markets and to reduce the unemployment rate. For example, France, which had very slow labor force growth (0.5 percent per year) in the 1979–1988 period, had a 4.5 percent *increase* in the unemployment rate. Similarly, Germany and Italy had labor force growth rates of just under 1 percent per year in this period (close to the rate predicted for the U.S. in the 1990s), while the unemployment rate in both countries went *up* about 3½ percentage points.

Germany and Italy had labor force growth rates of just under 1 percent per year in [the 1979–1988] period while the unemployment rate in both countries went up about 3½ percentage points.

TABLE 9
Labor Force Growth and Other Economic Indicators, 1979–1988
(Selected OECD Countries)

Country	Labor Force	Manufacturing Compensation[1]	Productivity[2]	Change in Unemployment Rate
		(Annual Rates of Change)		
France	0.5%	2.0%	1.9%	4.5%
U.K.	0.7	2.3	1.8	2.9
Germany	0.9	2.4	1.5	3.4
Italy	0.9	1.6	1.8	3.5
Japan	1.1	2.1	2.9	0.4
U.S.	1.7	0.4	1.0	−0.3

[1] Real hourly compensation.
[2] Gross domestic product per employee, 1979–1987.

Source: OECD.

One obvious reason for these disjunctures between labor force growth and change in the unemployment rate is productivity growth. Compared to the U.S., these countries all had relatively high rates of productivity growth, which helps explain how their unemployment rates could go up, even while new workers were in short supply. Conversely, the low productivity growth rate in the United States helps explain how our unemployment rate could go *down*, even with a relative abundance of new workers. (This trend has become even sharper in the recent past (1984–1990), with a three-point drop in the unemployment rate, accompanied by falling real wages.)

While the proportion of minority labor force entrants will increase somewhat, it is not clear that the labor force will be dominated by low-skill minority and "disadvantaged" workforce entrants.

Thus, with attendant positive changes in the unemployment rate and wage growth, extrapolating from slow labor force growth to an aggregate labor shortage is not justified by the recent experience of industrialized countries. In fact, this experience suggests that slow labor force growth could be associated as easily with an *increased* unemployment rate as a decreased one. Furthermore, an aggregate shortage, even if it appeared, is no guarantee of strong wage growth. This would appear to depend on increasing labor productivity and other factors bearing no clear one-to-one relation to the tightness of the labor market.

Changes in Labor Force Composition

The other part of the "labor shortage" argument is the claim that a *specific* shortage of workers with adequate levels of skills and education will appear in the 1990s. This is because the skill levels of jobs will go up dramatically while, at the same time, the slow-growing labor force will be increasingly dominated by minority and other disadvantaged workforce entrants with low skill levels. The resulting *skills mismatch* between available jobs (presumed to be in professional, technical, and other high-skill occupations) and available workers will lead to a shortage of adequately skilled and educated workers.

We have already seen that one side of this argument is suspect. It is clear that skill levels in the job structure are not rising as fast as described in the *Workforce 2000* report and similar analyses. Skill levels may, in fact, be rising rather slowly, depending on the magnitude of within-occupation skill changes, which in turn, is dependent on such imponderables as managerial strategies, market pressures, public policy initiatives, etc. Indeed, the problem with job skills is that they may be going up too little (given the exigencies of international competition), rather than too much.

The other side of the skills mismatch argument—changes in labor force composition—has more merit. However, while the proportion of minority labor force entrants will increase somewhat, it is not clear that the labor force will be dominated by low-skill minority and "disadvantaged" workforce entrants. There are several reasons to be very skeptical of this claim.

To understand these reasons, it is first necessary to clarify what we should look at when we look at "workforce entrants." Workforce entrants, properly defined, should include the *total* number of workers who enter the workforce over a period of time, both those who *replace* workers exiting from the workforce (from death or retirement) and those who add to the total number in the workforce. For example, in an economy of 100 workers, 20 workers might come into the workforce over ten years, while ten retired over the same period of time, resulting in a workforce of 110 (100 + 20 − 10) at the end of the period. But, despite the fact the net increase in the workforce was only ten (110–100), the actual number of workforce entrants should still be set at 20, so that we can include the ten workers who replaced those retiring.

The conventional analyses . . . only look at the net increase in the workforce and ignore those workforce entrants who, in effect, replace exiting workers.

Now a lot of the conventional analyses don't do this. They only look at the net increase in the workforce (in our example, the rise of ten) and ignore those workforce entrants who, in effect, replace exiting workers. This was the basis upon which the famous chart in *Workforce 2000* was constructed; the chart showing that native white males comprise only 15 percent of workforce entrants to the year 2000, compared to 47 percent of the total workforce in the base year of 1985 (p. 95).[21] According to the chart, the places of native white males in the workforce will be taken by nonwhites (20 percent of workforce entrants), immigrants (22 percent) and women (64 percent).[22]

But the focus on net entrants distorts the picture, ignoring the many workers who simply replace those exiting from the workforce (see Labor Month in Review, *Monthly Labor Review*, January 1989). This is the reason, for example, why white males make up a such a small proportion of workforce entrants, calculated on a net basis. Since white males are easily the largest group of workforce *leavers*, most white male workforce entrants simply replace these leavers, rather than contributing to a net increase in the workforce.

The data in Table 10 illustrate this point. While white non-Hispanic males will make up only about 12 percent of net workforce entrants, *they will actually be almost one-third (32 percent) of total workforce entrants.* This is because white non-Hispanic men will be the dominant group (almost one-half) of workforce leavers. Thus, white non-Hispanic workforce entrants have to replace all these workforce leavers before they can contribute to net workforce growth—hence, the deceptively low figure of 12 percent.

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TABLE 10
Workforce Entrants and Leavers, 1988–2000[1]

Group	Total Entrants (percent)	Leavers (percent)	Net Entrants (percent)	Education Levels[2]: Percent Completed: High School (percent)	Education Levels[2]: Percent Completed: College	Education Levels[2]: Mean Education Level
Total	100.0%	100.0%	100.0%	88.6%	25.6%	13.2
Men	48.4	57.1	38.0	86.5	25.2	13.1
Women	51.6	42.9	62.0	91.1	26.2	13.4
White Non-Hispanic	66.8	83.0	47.3	91.6	27.9	13.5
Men	31.6	48.2	11.6	90.0	27.7	13.4
Women	35.2	34.8	35.7	93.6	28.2	13.5
Black	12.5	10.0	15.7	86.3	16.6	12.9
Men	5.7	4.8	6.7	84.9	15.3	12.8
Women	6.9	5.2	9.0	87.7	17.7	13.0
Asian and Other	5.5	2.2	9.6	91.4	40.6	14.0
Men	2.9	1.2	4.9	89.8	40.0	14.0
Women	2.6	0.9	4.7	93.4	41.5	14.1
Hispanic	15.1	4.9	27.4	63.2	12.0	11.1
Men	8.3	2.9	14.8	58.6	10.7	10.7
Women	6.8	2.0	12.7	70.5	13.9	11.7

[1] BLS moderate growth projection.
[2] Labor force participants, aged 25–34.

Source: Fullerton (1989), Table 14; and tabulations of 1988 CPS Earnings file.

White non-Hispanics (males and females) will constitute almost exactly two-thirds of total workforce growth.

Similarly, while white non-Hispanics (males *and* females) will contribute less than one-half (47 percent) to net workforce growth, they will constitute almost exactly two-thirds of total workforce growth. And, on the other side of the ledger, minorities will contribute more than half (53 percent) of net workforce entrants, while being a little less than one-third (33 percent) of total workforce entrants. These figures do not suggest a workforce where whites (particularly males) are virtually a disappearing species, but rather one where whites (including males) will continue to dominate. This is borne out by figures on the overall composition of the workforce, which show the share of white non-Hispanics dropping only modestly—from 79 percent to 74 percent—while the share of blacks and Hispanics rises from 18 percent to 22 percent (most of this increase comes from Hispanics).

As with projected changes in job skills, the expected change in the demographic composition of the workforce needs to be viewed in a historical context. For example, minority workers becoming an increasingly important part of the labor force is not just an event that is expected to happen, it is well underway. In fact, the portion of the labor force composed of minorities increased as much (or more) over the 12 years prior to 1988 as it is expected to increase in the 1988–2000 period (see Fullerton, 1989, Table 1). That said, we agree that since many minority workforce entrants (particularly Hispanics) do suffer from educational deficits, there is a case to be made for special efforts to make up these deficits (for example, ESL classes for immigrants, dropout prevention programs, expanded access to college programs). Such special efforts, however, should not hinge on engendering a sense of crisis through misleading figures on workforce entrants.

Finally, it should be noted that it is technically possible to construct a typology of the "disadvantaged" that would put them in the majority of workforce entrants. This is usually done by combining minorities with women, under the assumption that women have lower skills than men. Such a disadvantaged category does include a strong majority (68 percent) of workforce entrants (see Table 10).

There is only one problem: women as a group don't really belong in this category. While it was once probably reasonable to assume that women as a group did have substantially lower skills and educational attainment than men, this is no longer a tenable assumption. As Table 10 demonstrates, women labor force participants are now actually *more* likely to have graduated from high school (91.1 percent to 86.5 percent for men) and are *more* likely to have completed college (26.2 percent versus 25.2 percent for men). The greater educational attainment of women labor force participants is evident among whites and blacks, but even more so among Hispanics.

Women as a group don't really belong in [an educationally disadvantaged category:] women labor force participants are now actually more likely to have graduated from high school and are more likely to have completed college.

We do not wish to imply, however, that labor market differences between young men and women have been completely eliminated. For example, there may still be skill differences due to differing content in educational training. It must also be acknowledged that men and women continue to receive different remuneration for similar work and that this is at least partially due to wage discrimination. But none of this is sufficient to characterize women as educationally "disadvantaged."

Since minorities will not dominate as new workforce entrants and women as a group should not be included among the educationally disadvantaged, the argument that the future workforce will be *dominated* by low-skill, disadvantaged workforce entrants clearly lacks empirical foundation. Does this mean the skills of the workforce—present and future—do not constitute a problem?

Again, we feel there is a problem, but it is different—or at any rate, broader—than the one people generally think about. We have already said that the greater role of minorities in the workplace does imply the need to raise the high school and college completion rates of minorities. We believe, however, that an equal, if not larger, problem lies in the generally inadequate *content* of American education and employer training, especially relative to that received by students and workers in other countries (see Bishop, 1989; Kazis, 1989; and Teixeira and Swaim, forthcoming, for summaries of the evidence on this issue).

We believe that the problem with American workers and students lies less in the decline of their cognitive skills over time and much more in the abysmal inferiority of these skills relative to their counterparts in many other societies, particularly our economic competitors.

The point about the comparative international context of education and training is crucial. We believe that the problem with American workers and students lies less in the decline of their cognitive skills over time (in fact, the magnitude of this decline tends to be considerably exaggerated[23]) and much more in the abysmal inferiority of these skills relative to their counterparts in many other societies, particularly our economic competitors.

Because of this, there seems little doubt that our economic competitors have a broader base of workforce cognitive skills with which to pursue technological innovation and productivity enhancement than we do. This is clearly a problem, but, equally clearly, it has little to do with the changing demographic composition of the workforce. Instead, it has everything to do with the quality of the U.S. workforce as a whole, of which changing demographics is only a relatively minor aspect.

Overall Wage and Income Trends

Previous sections have reviewed the expected skill and educational requirement trends and the anticipated changes in the size and composition of the labor force. We have gone beyond the conventional analysis of these trends by assessing their overall impact and by placing them in their historical context. This section broadens the analysis to include what the conventional wisdom leaves off the table: how expected changes in the job structure are likely to affect the standard of living of the American workforce. To pursue this inquiry, we examine past and future wage trends and income growth.

A distinctive aspect of recent income growth is that there has been so little of it.

A distinctive aspect of recent income growth is that there has been so little of it. For instance, median family income (in 1989 dollars) grew from $32,844 in 1979 to $34,213 in 1989, a growth of just $137 (0.4 percent) per year. In contrast, median family income grew $779 (2.7 percent) each year between 1967 and 1973, or some six times faster. Family incomes also grew slowly in the 1973 and 1979 period (0.9 percent or $283 annually).

The slowdown in income growth can also be seen in terms of per capita incomes, which grew just 1.45 percent annually from 1979 to 1988, or about half as fast as in the 1948 to 1973 period (see Table 11). Further insight can be gained by disaggregating per capita income growth into its demographic component—the ratio of adults to children—and the underlying income growth per adult. This is necessary since per capita income will grow simply if an increased proportion of the population are adults (who receive most of the income) and a decreased proportion are children (who receive hardly any direct income). Disaggregating in this manner shows that recent adult income growth has been at a rate (1.18 percent) just 40 percent of that achieved in the early post-war period.

TABLE 11
Per Capita and Per Adult Income Growth

	Income Growth		
	Per Capita	Per Adult	Adult/ Population
		(Log Annual Rates)	
1948–1967	2.58%	2.90%	−0.32%
1967–1973	3.16	2.42	0.74
1973–1979	1.72	0.86	0.86
1979–1988	1.45	1.18	0.27
1988–2000	1.69	1.56	0.13

Source: Authors' calculations. See Appendix for details.

There has also been an important change in the *character* of income growth; that is, an acceleration of property income growth while compensation growth has collapsed (see Table 12). Or, in other words, a much larger proportion of total income growth in recent years has been accruing to owners of property (stocks, bonds, real estate, and so on). For instance, property income per adult grew 3.7 percent annually from 1979 to 1988, substantially higher than the growth of the 1967 to 1979 period but less than in the earlier post-war period.[24] Reflecting this trend, property income accounted for a very large share of recent income growth (22.6 percent), much larger than in earlier periods.[25]

There has also been an important change in the character of income growth; that is, an acceleration of property income growth while compensation growth has collapsed.

There are several important implications of this shift toward property income. One consequence is increased income inequality since property income disproportionately accrues to the richest 10 percent of the population. Another worrisome aspect is that this acceleration in property income primarily reflects *higher* returns to wealth rather than rapid growth in wealth (which has actually decelerated). It is the high real interest rates of the 1980s, not additions to wealth, which are responsible for the boom in property income (see Mishel and Frankel, 1990).

What matters most to the majority of families, however, is compensation growth. There are two components to compensation growth per adult (see Table 13). One component reflects changes in hours worked per adult—a measure of the degree to which families are "working harder" or "more" (for example, through more two-wage earner families). The other component is the growth of hourly compensation. Thus, total labor income per adult can increase through "working harder" and/or through "higher pay."

TABLE 12
Income Growth By the Type of Income

	Compensation Per Adult	Property Income Per Adult*	Contribution to Total Growth of Income Per Adult: Total	Compensation	Property Income Growth	Self-Employed Income
			(*Log Annual Rates*)			
1948–1967	3.25%	4.48%	100.0%	76.3%	16.3%	7.5%
1967–1973	2.60	1.42	100.0	75.9	12.3	11.8
1973–1979	0.85	2.44	100.0	74.6	16.6	8.8
1979–1988	0.83	3.70	100.0	70.0	22.6	7.4
1988–2000	1.26	2.95	100.0	67.9	24.7	7.5

* Interest, Dividend, and Rental Income.

Source: Authors' calculations. See Appendix for details.

TABLE 13
Labor Income Growth

	Productivity*	Compensation Per Adult	Hours Per Adult	Compensation Per Hour	Contribution to Total Growth of Compensation Per Adult: Total	Hours Per Adult	Compensation Per Hour
			(*Log Annual Rates*)				
1948–1967	2.58%	3.25%	0.38%	2.87%	100.0%	11.7%	88.3%
1967–1973	1.70	2.60	−0.21	2.81	100.0	−8.1	108.1
1973–1979	0.48	0.85	−0.07	0.92	100.0	−8.2	108.2
1979–1988	1.24	0.83	0.14	0.69	100.0	16.9	83.1
1988–2000	1.34	1.26	0.21	1.05	100.0	16.7	83.3

* Nonfarm business output per hour growth.

Source: Authors' calculations. See Appendix for details.

The data in Table 13 show that since 1979, labor income growth has not only been historically low, *it has also increasingly come from "working harder" rather than from "higher pay."* For example, Table 13 shows a collapse of hourly compensation growth in the 1980s, despite an acceleration of productivity growth. In fact, hourly compensation growth since 1979 has been minimal, just 0.69 percent annually, and just one-fourth of the rate in the pre-1973 period. (Other data suggests that hourly compensation may even have fallen during the 1980s; see Mishel and Frankel, 1990). Finally, hours worked per adult has been rising since 1979, reversing the 1967–1979 decline, and contributing 16.9 percent of the total rise in adult compensation growth.

These aggregate changes in labor income mask important trends for subgroups of the workforce and different types of pay. An analysis of the underlying components of hourly compensation growth shows a collapse of fringe benefit growth (falling from 6.24 to 0.30 percent annual growth) and a pickup, but still small growth, in hourly wages (see Table 14). Despite overall wage growth, however, real hourly wages of the great bulk of the labor force—the over 80 percent of wage and salary workers who are production or nonsupervisory workers—*declined* significantly in the 1980s. (Much of this can be explained by the shift to low-wage industries (see Mishel, 1989; Costrell, 1988).) *Falling average real wages for a majority of the workforce is probably the most distinguishing characteristic of income growth in the 1980s.*

Falling average real wages for a majority of the workforce is probably the most distinguishing characteristic of income growth in the 1980s.

TABLE 14
Growth of Wages and Compensation Per Hour

	All Workers			Nonsupervisory and Production Workers*	
	Compensation Per Hour	Fringe Benefits Per Hour	Wages and Salaries Per Hour	Wages Per Hour	Compensation Per Hour
	(*Log Annual Growth Rates*)				
1948–1967	2.87%	7.58%	2.72%	2.44%	2.60%
1967–1973	2.81	7.81	2.51	2.16	2.48
1973–1979	0.92	6.24	0.48	0.24	0.70
1979–1988	0.69	0.30	0.73	−0.67	−0.60
1988–2000	1.05	0.57	1.09	N.A.	N.A.

* This group comprises over 80 percent of wage and salary employment.

Source: Authors' calculations. See Appendix for details.

The issue is not only whether incomes and wages will grow but also whether the earnings of large segments of the workforce will even recover to their levels of the late 1970s.

These adverse labor market trends have affected the earnings of young workers the most, particularly the three-fourths of young workers who do not have a college degree. Katz and Murphy (1990) report that in 1987, young male high school graduates with one to five years experience earned real weekly wages 20 percent lower than in 1979 and less than in 1963.

Similarly, Harrison and Gorham (1991) report that real wages for workers aged 25–34 fell 7 percent from 1979 to 1987. The wages of young black and white men in this age group fell even more: 22 percent and 10 percent, respectively. Finally, the wages of young black women, who already had very low earnings, fell 4 percent.

This wage deterioration among the vast majority of workers and young workers in particular, should set the context for how we evaluate income and wage trends in the 1990s. *The issue is not only whether incomes and wages will grow but also whether the earnings of large segments of the workforce will even recover to their levels of the late 1970s.*

To investigate this issue, we used the BLS economic projections of jobs and incomes to the year 2000 (results shown in Tables 11–14). Per capita income growth to the year 2000 is expected to remain sluggish at the growth rate of the post-1973 period (see Table 11). A somewhat more optimistic indicator is adult income, where annual growth is expected to rise to 1.56 percent. This is significantly better than recent experience but far below the early post-war growth rate. Property income, however, will continue to comprise a large share of income growth (nearly one-fourth), suggesting further increases in income inequality (see Table 12).

Future compensation growth is expected to have the same character as that of recent years (see Table 13). Hourly compensation growth will be somewhat better than in the 1979–1988 period (1.05 percent vs. 0.69 percent), but not much different than in the 1973–79 period (1.05 percent vs. 0.92 percent), and far worse than pre-1973 standards. Moreover, hourly compensation growth will continue to be significantly less than the expected increases in productivity. Finally, hours worked per adult will continue to increase at about the 1979–1988 rate.

Whether hourly compensation for production and nonsupervisory workers will reverse its decline cannot be derived from the BLS projections and remains a critical question. One indication of the trend is that average hourly earnings for these workers have been falling since both 1986 and 1988, the base years for the projections to the year 2000.

There are reasons to believe that wages will not accelerate in the 1990s as much as the BLS projections imply (which are based on a Data Resources Inc. (DRI) model). This is because the equation used to estimate future wage growth does not adequately take into account the major changes in the wage setting process that have occurred in the 1980s. For example, both union and nonunion wages grew more slowly in the late 1980s than would have been predicted by trends in inflation, unemployment, and productivity (see Wachter and Carter, 1989).

There are reasons to believe that wages will not accelerate in the 1990s as much as the BLS projections imply. If so, this could mean the same thing as in the 1980s for the majority of the workforce: continued stagnant or falling average real wages.

This shift to lower wage growth is the result of institutional changes in the labor market, including lessened worker bargaining power, and the rise of performance pay systems and contingent work (see Mitchell, 1989). If, as we expect, this trend toward weakened wage growth is not reversed, then the BLS projections may severely overstate future wage growth.

The possible overprediction of wage growth by the BLS/DRI model is further suggested by an analysis of the wage equation performance in recent years.[26] The model accurately predicted wage growth through 1985 but overstated cumulative wage growth from the end of 1985 to the end of 1989 by roughly 2.5 percent. And, for 1988 and 1989 (the first two years of the BLS projections), the overprediction was about 0.7 percent each year.[27] Thus, errors in prediction could account for most of the 1.09 percent annual growth in wages predicted by BLS. Given these overpredictions of recent wage increases, it is plausible that wage growth in the 1990s will not be as high as projected by BLS—perhaps at best equalling the sluggish growth of the 1980s. If so, this could mean the same thing as in the 1980s for the majority of the workforce: continued stagnant or falling average real wages.

Conclusion

The evidence reviewed above casts considerable doubt on the conventional wisdom concerning the evolution of the U.S. economy and the future of the American worker; the conventional wisdom we have characterized as the "labor shortage/supply push" viewpoint. In fact, we have shown that the main tenets of this conventional wisdom are either wrong or misleading and, in crucial respects, actually point us in the wrong direction for dealing with continuing economic change. In our view, the future of the American worker, absent conscious and sustained policy intervention, is more likely to look like the following:

We have shown that the main tenets of [the "labor shortage/supply push" viewpoint] are either wrong or misleading and, in crucial respects, actually point us in the wrong direction for dealing with continuing economic change.

* Increases in job-skill requirements due to upgrading of the occupational structure will be modest and less than in the past. Furthermore, while skill changes *within* jobs could conceivably have a large impact, there is no evidence that such large-scale job enrichment will take place. Thus, rather than *too much* upskilling of the job structure in the 1990s, there may be *too little*.

* A general labor shortage will not occur simply because the labor force will grow slowly in the 1990s. Nor will the changing demographics of the workforce necessarily produce a serious shortage of adequately skilled workers. While an increased proportion of minorities among workforce entrants does pose a problem that needs to be addressed, the assertion that *most* future labor force entrants will be minorities or otherwise educationally "disadvantaged" is simply not true. A more important problem with workforce entrants will be that the quality and content of education received by most entrants, minorities *and* whites, may not provide an adequate basis for future technological innovation and productivity growth.

* Projected economic trends will not eliminate the income problems of the 1980s—slow overall income growth and declining compensation for a majority of the workforce. For example, wages will continue their sluggish growth in the 1990s and may, as in the 1980s, fall for large portions of the workforce.

The key policy implication of this scenario is that *the "supply push" approach will not produce desired improvements in labor market performance or productivity.* This is because the obstacles to U.S. economic growth do not lie only, or even mainly, with the quality of the workforce. Just as important (perhaps even more so) are demand-side problems rooted in the sluggish response of U.S. employers to changing technological and market conditions. Workers cannot fill high-skill jobs if such jobs are not widely available, regardless of their levels of "human capital." Thus, simply improving human capital levels—whether this be through greater education and training of American workers or through higher immigration levels of educated workers—is not, and will not, be an adequate response to our labor market problems.

Instead, emphasis should be put on implementing technology and reorganizing work based on higher levels of skill to achieve high-productivity growth. This means elaborating a positive program to encourage the "high-skill path" throughout the economy, especially with reference to employer strategies in the workplace, since different strategies lead to different skill levels of jobs. One component of such an approach is adopting policies that essentially force employers to train and use more highly skilled workers.

For example, we should consider adopting a uniform training levy—a 1 percent payroll tax—that employers would either have to pay to the government or use internally for the upskilling of work and workers. This would be one way to constrain the choices available to employers and encourage the high-skill approach to work reorganization.

Emphasis should be put on implementing technology and reorganizing work based on higher levels of skill to achieve high-productivity growth. This means elaborating a positive program to encourage the "high-skill path" throughout the economy.

Of course, policy initiatives to encourage the high-skill approach should not be limited to a payroll tax. Choice among other policy options should be guided by a basic principle: employers face a choice between the high-skill and low-skill approaches to work organization, so policy should make it more difficult for them to select the low-skill approach. Thus, policy alternatives like works councils and worker participation in management should be encouraged, since they make it more difficult to rely on low-skill, routinized work organization.

Another important policy implication is that substantial upgrading of the U.S. workforce cannot be accomplished through simply improving the skills of minority or "disadvantaged" workforce entrants. Instead, the key lies in improving the skills of the workforce *as a whole*, both workforce entrants (including minority entrants) and those already in the workforce. Moreover, the point of improving workforce skills should not be to "match" the skills required for an improbable future explosion of professional/technical and other high-skill jobs, but rather to provide a solid base of workforce quality from which a widespread upgrading of job content, as described above, can be pursued.

This suggests that training and educational policies are properly viewed as *active* policies that might alter our growth path rather than *reactive* policies that passively adapt to existing or expected jobs. In this sense, broad upgrading of worker skills, coupled with policies that encourage employers to utilize a more highly skilled, more empowered workforce, can become a constituent part of a policy mix favoring a "high-skill path" for the U.S. economy as a whole.

A final and critical policy implication is that an upgrading of workers' living standards is not likely to happen through the "natural progression" of current economic trends. The key instead lies in achieving greater wage growth, part of which entails higher productivity growth. Higher productivity growth, in turn, will be hard to attain without adopting the high-skill path for the economy described above.

But even attaining higher productivity growth may not be enough. This is because there has been a slowdown in wage growth relative to both productivity and property income growth, reflecting the overall weakening of workers' bargaining power, union *and* nonunion. Thus, it will probably also be necessary to redress the weakened bargaining power of workers (for example, through reforming labor laws, raising the minimum wage back to historic levels, etc.) in order to achieve satisfactory wage growth. In this sense, the "high-skill path" for the economy should be identified more broadly as the "high-skill, *high-wage* path."

But even attaining higher productivity growth may not be enough. It will probably also be necessary to redress the weakened bargaining power of workers in order to achieve satisfactory wage growth.

Appendix

General Methodology

When considering the possibility of a future mismatch between the skill levels of jobs and the skill levels of workers, the hypothetical mismatch can be defined in a number of different ways:

(1) between new jobs and workforce entrants;

(2) between the overall job structure and workforce entrants;

(3) between new jobs and the workforce as a whole; and

(4) between the overall job structure and the workforce as a whole.

These possibilities are illustrated in Table A-1 below.

TABLE A-1
Possible Mismatches between Workforce and Job Structure

	New Workers	All Workers
New Jobs	1	3
All Jobs	2	4

This definitional distinction between possible types of mismatches is poorly understood, as evidenced by the way data is adduced to support the skills mismatch thesis. The implicit definition of the skills mismatch in *Workforce 2000* and most other analyses is between skill levels in the job structure as a whole and the skill levels of workforce entrants (box 2), while the *data* offered as evidence for this mismatch is typically about *new* jobs and workforce entrants (box 1).

This disjuncture between definition and evidence is unacceptable for a number of reasons. First of all, even assuming that one should confine one's attention to workforce entrants (boxes 1 or 2), it makes little theoretical sense to focus exclusively on new jobs (box 1). The jobs potentially available to workforce entrants include not only newly created jobs but also "old" jobs as they become available through promotions, quits, retirements, and death. In other words, new workers are not neatly channeled to new jobs, but rather diffused through the job structure as a whole as they enter into the labor market. This is illustrated by the fact that the number of projected workforce entrants (42.8 million) is more than twice the number of projected new jobs (18.1 million).

This suggests it is preferable to look at the job structure as a whole (box 2), as implied by the popular definition of the skills mismatch. This is essentially what our analysis focuses on when we look at the effects of compositional shifts on average pay and skill levels.

So far we have confined our discussion to the *rows* of Table A-1—i.e., the distinction between analyzing new jobs and all jobs when looking at changes in the job structure. But what of the columns? What of the distinction between analyzing new workers and all workers when looking at changes in the workforce?

As we mentioned earlier, discussions of future worker-job mismatches tend to be confined, on the worker side of things, to the question of workforce entrants, so this distinction is essentially ignored. Following this standard practice, we have looked only at workforce entrants when analyzing the worker side of the mismatch in this report. Our point has been that, even if one wishes to look just at workforce entrants, it is necessary to look at *total* workforce entrants rather than *net* workforce entrants, in order to avoid getting a distorted picture.[28]

While we have followed the standard practice of examining the characteristics of entrants and tried to make it more accurate on its own terms, we are not sure that the standard practice is correct. In fact, we believe that the distinction between new workers and all workers is pertinent and that a strong case can be made for examining the mismatch between *all workers* and the job structure as a whole (box 4), rather than just between workforce entrants and the overall job structure (box 2). This is because competition for available jobs is not confined to workforce entrants and, especially, because the task requirements of jobs held by old workers may change. This means that the question of future workforce quality cannot logically be confined to the question of the quality of workforce entrants (as proxied in most analyses and in this report by demographic characteristics), but should address the quality of the projected future workforce as a whole (hence shifting the analysis to box 4 in the diagram). Without this broader perspective, one might miss large changes which affect incumbent workers and the existing job structure, both of which dominate the total labor market. We intend to pursue this line of analysis further in a subsequent report.

A remaining issue is how one should examine or characterize changes in the job structure, such as changes in the occupational composition of employment. Many analyses have focused on the relative growth rates of different occupations while other analyses have focused on the absolute growth in employment. Both methods are misleading. Our method is to examine how changes in the occupational structure affect average pay or skill levels by "shift-share" analyses which take into account the amount of compositional shifting and the differences between expanding and shrinking occupations. The more an occupation expands or contracts its employment *share*, the more weight it is given in our analyses.

TABLE A-2
Employment Levels, Growth Rates and Changes in Employment Share

Occupation	Period 1 Employment Level (*millions*)	Period 1 Share	Period 2 Employment Level (*millions*)	Period 2 Share	Growth Rate	Change in: Employment Level (*millions*)	Change in: Share
#1	10	10%	20.0	13.3%	100%	10.0	3.3%
#2	30	30	60.0	40.0	100	30.0	10.0
#3	15	15	22.5	15.0	50	7.5	0.0
#4	30	30	42.0	28.0	40	12.0	−2.0
#5	15	15	5.5	3.7	−63	−9.5	−11.3
Total	100	100	150.0	100.0	50	50.0	0.0

Table A-2 illustrates the problems with examining either rates or levels of growth and the importance of examining employment shares. First, comparing occupations #1 and #2, we note that both occupations have the same growth rates (100 percent), double the average growth rate of 50 percent. Because occupation #1 is much smaller (10 million or 10 percent of the workforce in period one), it is clearly not as important in the overall job structure, even though it grows as quickly as occupation #2. This can be seen by the fact that an additional 10 percent of the workforce end up in occupation #2, while only an additional 3.3 percent end up in occupation #1. So, one needs to examine the initial size of a group as well as its growth rate.

Second, comparing occupations #1 and #4, we note that #4 has a larger change in employment (12 million vs. 10 million), but, since occupation #4 started from such a large base (30 million), this larger change of employment level is consistent with a *smaller* employment share in the second period. So, a large change in employment level does not necessarily imply increased importance in the economy.

Third, since occupation #3 grows only at the average growth rate (50 percent), this occupation has no change in employment share and cannot affect skill levels (or any other characteristic of the job structure) despite adding 7.5 million jobs.

Finally, occupation #5 has the most significant shift in employment share (down 11.3 percent), despite having the second lowest change in employment level (down 9.5 million).

All these points illustrate how the central role of changes in employment share cannot be captured accurately by data on the number and type of new jobs and/or the relative growth rates of different occupations or types of occupations. The key to properly analyzing compositional change in the job structure lies instead in analyzing *the exchange of shares between occupations* (in our example, 13.3 percent employment share is exchanged between occupations #4 and #5 (shrinking) and occupations #1 and #2 (expanding)).

This concept is helpful in understanding data presented in the report on the skill (and pay) gaps between expanding and shrinking occupations (see Tables 3 and 8). In our example, we would compare the skill level of expanding occupations (#1 and #2) to the skill level of shrinking occupations (#4 and #5). This would be done by saying the skill level of expanding occupations is 75.2 percent due to occupation #2 (10/13.3) and 24.8 percent due to occupation #1 (3.3/13.3). Similarly, the skill level of shrinking occupations is 15 percent due to occupation #4 (2/13.3) and 85 percent due to occupation #5 (11.3/13.3). These computations allow the skill gap between expanding and shrinking occupations to be assessed (which could then be combined, if one wished, with information about the shift in employment share to generate the overall shift effect on skill levels). Again, all this illustrates the centrality of analyzing employment share changes when assessing shifts in the job structure.

Industrial and Occupational Data

The industrial and occupational shift effects are based on separate shift-share analyses of major occupations and industries (see Tables 2, 3, 7, and 8). The industrial analysis consists of payroll employment in nine one-digit industrial classifications (e.g., mining, construction, durable manufacturing) in the private, nonagricultural economy. Analysis of the occupational data is of civilian employment in the ten major occupational groups, excluding farming, forestry, and fishing.

The coverage of the two data sets differ in that the occupational data include the public sector and agricultural workers not in the farming, forestry, and fishing occupation (a small group). The use of an additional category for occupations (10 versus 9) slightly biases the results towards showing larger effects of occupational change.

The aggregate nature of the categories was dictated by the fact that the revisions of the occupational definitions eliminated all historical series other than the one published by BLS of major occupational categories (Klein, 1984). As it turns out, however, a more disaggregated analysis would probably not yield differing results. For example, that was the case when we analyzed BLS occupational projections with both a ten category and with a forty-six category breakdown. In addition, Costrell (1988) shows that a more disaggregated historical analysis of industrial shift effects yields results comparable to our aggregate analysis.

It should be noted that the industrial data are more reliable than the occupational data because they are derived from establishment surveys rather than household surveys. BLS Associate Commissioner Tom Plewes (1990, p. 7) recently wrote that "occupational data from households may be expected to continue to have notorious shortfalls. These data suffer from improper specification, skill level inflation, underreporting, and imprecision. Accordingly, for many purposes, occupational analysis, particularly in an industrial context, will continue to rely primarily on information collected from establishments."

Comparison of occupational data from establishments and households shows that households report significantly more workers in higher skilled categories (the executive, sales, and professional shares are 4.0 percentage points more) and fewer in low skilled categories (clerical and service occupational shares are 3.6 percentage points lower). This is confirmed in earlier research by Mellow and Sider (1983). The historical household occupational data we use therefore could overstate occupational upgrading. The extent of this bias depends on the degree to which skill level inflation has *increased* since 1973.

Pay Levels

Hourly wage and compensation (wages and fringe benefits) data used in the shift-share analyses are drawn from the BLS Employment Cost Index series publication showing pay levels by major industrial and occupational groups in the private sector (see Tables 4 and 5). The data are for March, 1988.

It was necessary to derive the pay data for mining from the pay data on goods producing industries and the other constituent sectors (manufacturing and construction) using hours data from Table 6.11 of the National Income and Product Account (NIPA). Also, pay data for the three categories within the service occupations were derived by applying the structure of relative full-time weekly wages within this category to hourly wages and compensation. Finally, the ECI presents pay data for an aggregate of professional and technical workers which were then disaggregated based on the structure of relative full-time weekly wages. Shares of employment used for these disaggregations were taken from the full-year CPS employment counts.

Skill Indices

All skill indices in this report (see Table 7 and 8) are taken from the Dictionary of Occupational Titles (DOT), a compendium of occupational titles in common use in civilian U.S. labor markets. The compendium is based on survey information collected at irregular intervals by job analysts for the U.S. Employment Services. A variety of information about each occupational title is contained in the DOT, including ratings of the educational development, training time, physical capabilities, temperaments, and aptitudes necessary for the job. (For more information on how these ratings were constructed, including formal definitions and coding schemes, see the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972).) There have been

four editions of the DOT: 1939; 1949; 1965; and 1977 (a fifth is due out in 1991). The last of these contained information on some 12,855 different occupations.

The skill ratings for occupational groups in our analysis were based on scores from the 4th edition. The specific indices we used from this edition were the three worker functions (handling data, people, and things), two of the worker aptitudes (intellectual and verbal), the general educational development measure (GED), and the length of training or specific vocational preparation (SVP) measure (see Miller, Treiman, Cain, and Roos (1980) for useful discussions of each of these measures).

Aggregating from detailed DOT titles to occupational groups was done in the following manner. First, 4th edition scores for three-digit 1980 Census occupational codes were obtained from an ICPSR data set put together by England and Kilbourne (1988). (For the tangled history of how 4th edition scores were weighted into 1980 census codes, see England and Kilbourne, 1988, as well as Miller, et al., 1980, Appendix F). We then weighted the scores for 1980 three-digit occupational codes into aggregated groups, using a detailed occupational distribution drawn from the 1988 Current Population Survey (CPS) annual averages.

For Table 8, coding of two of the DOT indices—handling data and verbal aptitude—was modified so that the level of complexity increases with score instead of decreasing as in the original coding scheme. This coding change in no way affects the substantive nature of results presented in this table.

Educational Levels

The educational requirements of occupations are based on the educational levels of incumbents. These are drawn from unpublished BLS tables based on the March 1988 CPS (see Tables 2, 7, and 8). The educational level for each occupation is the median level and the distribution of workers by educational level, which are derived from wage and salary employment counts.

BLS does not tabulate educational levels of the workforce by industry. Our educational data for major industries are based on tabulations of the 1988 CPS earnings file for a sample of private nonagricultural wage and salary workers (see Table 2). Here, because of computational difficulties, we use mean rather than median educational levels.

Personal Income and Wage Data

The analysis of past income and wage growth is based on NIPA data (see Tables 11–14). Expected growth is based on BLS employment projections from the November 1989 *Monthly Labor Review* and unpublished tables, all of which match NIPA definitions.

Personal income is defined as the sum of all market-based incomes, both labor income (wages and fringe benefits) and property income (rent, dividends, and interest) with self-employed income (farm and nonfarm) not counted as either labor or property income but included in total personal income. These data are from NIPA Table 2.1 and are converted to constant dollars using the fixed-weighted personal consumption expenditure index.

Historical hours data are from NIPA Table 6.11, while Valerie Personick of BLS provided hours estimates for 1988 and 2000. Population and the number of adults are from the *Economic Report of the President*, Table B-31.

Productivity growth is based on the BLS series for the nonfarm business sector, with expected growth based on BLS estimates (Saunders, 1989, p. 24). Production worker average hourly earnings are from the BLS series with total compensation estimated by assuming, conservatively, that fringe benefits of production workers grew at the average rate in each time period (the ECI supports this for the 1979–1988 period, there are no data for earlier years).

Annual rates are expressed as natural log changes to facilitate the decompositions of total growth. For instance, compensation per adult equals the product of hours per adult and compensation per hour. Given this, the log change of compensation per adult equals the sum of the log change of hours per adult and the log change of compensation per hour, thus allowing total growth in compensation per adult to be distributed to the two factors. The contribution analysis in Table 12 is based on the share of the change in the specific income component relative to the total change (i.e., neither in logs nor annualized).

Endnotes

[1] This is the introductory paragraph of a November 16, 1990 cover letter for the distribution to the U.S. Department of Labor (1990).

[2] See, for example: "Needed: Human Capital," *Business Week*, September 19, 1988; "A Centennial View," *The Wall Street Journal*, June 29, 1989; "Education at Work," *The Washington Post*, August 6, 1989 ; "Skills Vs. Jobs," *New York Times*, September 25–27, 1989; and "Education: The Knowledge Gap," *The Wall Street Journal*, February 9, 1990.

[3] This term was first suggested to us by Richard Rothstein.

[4] It is also true that a "skills mismatch" can occur even if skill requirements remain unchanged or grow modestly when the quality of the workforce is declining. To our knowledge, no one is arguing that this is the scenario behind the "developing skills mismatch."

[5] In fact, "skill inflation" in occupational data implies that our analysis *overstates* the significance of occupational upgrading. See Appendix.

[6] Other computations we have made suggest that these ratios may vary depending on the time period and data source used. For example, some alternative computations show stability in the ratios of the characteristics of expanding and shrinking occupations between the 1980s and the 1988–2000 projections. However, all computations show that the ratios of the characteristics of expanding and shrinking occupations will be narrower in the future than in the 1970s. Moreover, all alternative computations show substantially less occupational shifting in the future than in either the 1973–79 or 1979–1986 periods, as well as substantially less overall pay and educational upgrading due to occupational shifts.

[7] *Workforce 2000*, p. 98, Table 3–8. It should be noted that these figures, and others that purport to give "education requirements," are ultimately based on the amount of education actually achieved by job incumbents at a given time (in this case, 1984). In actuality, the true educational requirements of jobs in 1984 are not known, but are assumed to correspond to the educational levels of job incumbents.

[8] Education is only a rough proxy for the skills actually needed on a job. This is why it is desirable to look at direct measurements of job skill requirements. Such direct measurements can be obtained from the Dictionary of Occupational Titles (DOT), a detailed survey of occupations in civilian U.S. labor markets conducted by the U.S. Employment Service. The most recent, 4th edition of the DOT (1977) contains skill ratings of 12,855 different occupations.

The three skill scores quoted here are the three components of the DOT measure of General Educational Development (GED). For details on the GED and an explanation of the different skill levels for language (GED-L), math (GED-M), and reasoning (GED-R), see the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972).

[9] These statements are from Tom Plewes (1990, p. 7), BLS Associate Commissioner, and Janet Norwood (1990, p. 4), BLS Commissioner.

[10] The substantive complexity measure is a factor-analytic score created from DOT variables tapping general educational development, vocational preparation, relationship to handling data, and worker aptitudes. For more detail on this measure see Miller, Treiman, Cain, and Roos (1980), Appendix F.

[11] This comparison was done on the level of major nonfarm occupational groups, a relatively aggregated set (10) of occupational categories used by the Current Population Survey (CPS). This was necessary because the historical data available to us was on the major occupation level. However, while we could not use more disaggregated categories for the historical analysis, it was possible to do this for the projection analyses. These results, using the detailed (46) CPS occupational categories, show only minor differences from the projection estimates presented in Table 7.

[12] Our results appear to differ from their's primarily because our change estimates for the 1970s are lower than their's; not because our's from the 1980s are so high. Our relatively low estimates for the 1970s may reflect our exclusion of 1970–73 which, if like the 1960s, may have been years of relatively fast skill growth.

It should also be noted that McGranahan and Ghelfi (forthcoming), as well as alternative computations done for an extension of this paper, also show a slowdown in the 1980s relative to the 1970s. As with Howell and Wolff's, these other computations include the 1970–73 period.

[13] See Levin and Rumberger (1989) for an earlier analysis along similar lines. Their analysis is confined to educational categories and does not quantify rates of change. However, their basic conclusions about the effect of changes in the composition of employment on skill levels are similar to ours.

[14] It should be noted, however, that not all estimates show the same extent of future narrowing of the skill gaps between expanding and shrinking occupations. For example, some alternative computations (for an extension of our research) using different data sources and slightly different time periods suggest stability in the skill gaps between the 1980s and the projected years. However, all computations show that future skill gaps are less than those of the 1970s. All computations also show substantially less shifting and, most importantly, less overall change in skill characteristics in the projected years than in either the 1970s or 1980s.

[15] Our actual calculations on the Bishop/Carter data were performed in the following way. First, we crosswalked the occupational categories in the Bishop/Carter Table 12 into the 10 major nonfarm occupational categories we used for our analyses. Based on the crosswalk, we then performed exactly the same shift-share analysis on the Bishop/Carter data

that we performed on our own data, producing estimated shifts effects in each of the skill categories displayed in our Table 7. Sample shift effects (ten-year rates of change) from the Bishop/Carter data are: 3.3 percent for handling data, 1.8 percent for GED, and 1.7 percent for SVP (length of training).

[16] It should be noted that our findings in the previous section did not control for the effects of industry shifts on skill levels. This was because we wished to demonstrate that, even on the relatively favorable terrain used by *Workforce 2000* and other analyses, their claims do not hold up to close scrutiny. In a future report, however, we will present findings from a detailed industry-occupation analysis of structural change.

[17] "Goes beyond" should not be confused with simply "more of." For example, even at "best practice" firms, the level of academic skills required does not appear to be terribly high (see Levin, Rumberger, and Finnan, 1990; and Brown, Reich, and Stern, 1990). Instead, the key requirements are for the social and "higher-order" skills upon which problem-solving, adaptability, and team work are based.

[18] On the other hand, we must take issue with Bailey's analysis of occupational upgrading. His analysis, based on the 1988 BLS employment projection, makes essentially the same mistakes as the *Workforce 2000* report. By confining his analysis to the educational requirements of net new jobs, he exaggerates the effect of occupation shifts on job skill requirements. As discussed in section 2.3, this effect is modest and slowing down over time, so Bailey's use of occupational shifting as part of his upgrading argument must be questioned.

[19] Much the same could be said about other studies that connect upskilling to changes in the relative structure of wages (for example, Juhn et. al, 1989; and Katz and Murphy, 1990). The connection to upskilling typically relies on interpretive assumptions concerning the meaning of residuals or unobserved components of demand side change, or both. Direct evidence is notably lacking.

[20] The *Workforce 2000* report appears implicitly to recognize the problem. The baseline scenario for their analysis assumes a 7 percent unemployment rate in the 1990s, hardly an indicator of a tight labor market. Another scenario, their "world deflation" scenario, assumes almost a 10 percent unemployment rate, while even their most optimistic "technology boom," scenario assumes a rate of just under 6 percent (p. 56). Clearly these assumptions belie the tight labor markets predicted in other parts of the report.

[21] Though this is not made clear in the *Workforce 2000* chart or accompanying text, "white" is apparently defined to include Hispanics. Thus, the "native white" category also includes many Hispanics (immigrant Hispanics are included in the chart's immigrant categories), while the *non*-white categories include, for all practical purposes, only blacks and Asians.

[22] Women are included in the non-white and immigrant categories, so the three categories are not mutually exclusive.

[23] For example, results from the National Assessment of Educational Progress (NAEP) show only slight change in students' cognitive skills since the early 1970s: reading proficiency up slightly, science proficiency down slightly, and mathematics slightly up or slightly down, depending on age group (Ogle, 1990, Tables 1:4 and 1:6). As *The Condition of Education* puts it, "(s)tagnation at a relatively low level appears to describe the level of performance of American students. . ."

[24] The property income growth in the 1970s accelerated over that of the 1960s primarily because of pension legislation that required employers to place more funds in defined-benefit plans.

[25] This is also 50 percent greater than property's share of total income in 1979 of 14.9 percent.

[26] Niles Gault of DRI was kind enough to compare the predicted values against actual values for 1985 through 1989.

[27] The overprediction is somewhat lessened by adjustment factors in the model. On the other hand, the wage growth projections do not take into account the negative effect of employment composition shifts.

[28] Technically, this point also applies to the usual discussions of new jobs, since new jobs are usually taken to mean only *net* new jobs, with no accounting of jobs created that simply replace old, disappearing jobs in the economy. Thus, total new jobs may vary considerably from net new jobs. In fact, it would probably be instructive to construct a 3×3 table, that included net new jobs, total new jobs and all jobs on the rows, along with net workforce entrants, total workforce entrants and all workers on the columns. Lack of adequate data on disappearing or "dying" jobs in the economy makes this particularly difficult to do.

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